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VESTIBULO-OCULAR REFLEX PATHS

BY

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THE present paper is in the nature of an addendum to the Presidential Address, which was published in Vol. L of the *Transactions of the Ophthalmological Society*. Its aim is to describe the anatomical paths by which the labyrinth is able to establish the controls described in that paper. On that occasion, I spoke of the unceasing control exercised by the labyrinthine structures on the eyeballs, and I tried to indicate that, while there was evidence of a differentiation of function in the various parts of the labyrinth, the differentiation was not, by any means, complete, and it was possible that, after destruction of one portion of the labyrinth, other portions might vicariously take up the function of the destroyed portion. Beyond the acoustic functions and the ocular controls the labyrinth has a control over the muscle tone of the whole body, and on these controls depends the preservation of the body equilibrium. The anatomical paths concerned in the conduction of these various reflexes are naturally numerous and complex, and in many cases have not been fully worked out.

The labyrinth is the receptor organ for three types of impulse:—

(1) Gravistatic, resulting from variation in pressure on the maculae of the sacculus and utriculus produced by changes in the position of the head in space.

(2) Gravikinetic, produced by variations in pressure on the ampullae of the semicircular canals resulting from movements of the head.

(3) Rhythmical variations in pressure on the organ of Corti transmitted usually to the endolymph through the intermediary of the tympanic mechanism and giving rise to the sensation of sound, *i.e.*, mainly epicritic in character, but also having important dyscritic factors.

Our task would be greatly simplified if we could separate with any certainty the paths that these different impulses follow in the central nervous system. As far as the control of eye positions and movements is concerned, the simple gravistatic and gravikinetic controls are the two which really matter, but, in the present state of our anatomical knowledge, they cannot be, in any satisfactory way, separated from the paths of the impulses emanating from the cochlea. So we are compelled to consider the whole complex of paths and indicate only probabilities.

Diagram No. 1 from "*Körperstellung*" by Magnus represents the physiological connections of the sacculus and the utriculus with the various ocular muscles in the apes and man, and it is the anatomical paths by which these are linked up which we have to trace out.

COCHLEAR PORTION OF VIIITH NERVE

The cochlear root from the labyrinth enters the central nervous system distally, laterally and dorsally. The vestibular root is proximal, mesial and ventral. The cochlear root consists mainly of fibres from the cochlea which have passed through the ganglion spirale, but also may contain afferent fibres from the vestibule (especially macula sacculi) and efferent autonomic fibres from autonomic cells in the ventral nucleus of the VIIIth.

CONSTITUTION OF DORSO-MESIAL PORTION OF *OCTAVO-MESENCEPHALIC* TRACT (Diag. II)

The cochlear nerve entering the central nervous system sweeps up through the outer part of the ventral nucleus of the VIIIth. Some fibres pass into the ventral nucleus on its inner side. Above, it is capped by the tuberculum acousticum into which the bulk of the remaining fibres pass. A few fibres pass on in the striae acousticae to the proximal end of the nucleus triangularis. These latter fibres arise, in all probability, from the sacculus, and not from the cochlea. The main secondary acoustic tracts arising from the two primary nuclei, the ventral nucleus and the tuberculum

acousticum, pass into the dorso-mesial portion of the octavo-mesencephalic tract, which leads by way of the striae acousticae, the decussations of Monakow and Held and the lateral fillet to the posterior corpus quadrigeminum and the mesial geniculate of the opposite side. The bulk of the fibres cross by the dorsal decussation of Monakow and the mesial decussation of Held to the lateral fillet of the opposite side, *i.e.*, form a crossed vestibulo-mesencephalic tract, but a small bundle remains uncrossed, and passes up to the posterior corpus quadrigeminum of the same side. In this part of the octavo-mesencephalic tract, there are no nuclei intercalated between the two main primary nuclei and the posterior corpus quadrigeminum, and the mesial geniculate. With the fibres passing on to the auditory cortex we are not concerned, but the connection of the posterior corpus quadrigeminum with the anterior corpus quadrigeminum, and of the whole tectum by means of the fibrae radiales and the posterior longitudinal bundle with the oculo-motor nuclei, and by the pre-dorsal bundle of Held with the motor nuclei for the head and neck muscles supplies one of the centrifugal reflex paths with which we are concerned. Furthermore, from cells in the posterior corpus quadrigeminum fibres arise which pass downwards to the nuclei of the lateral fillet and from both the dorsal and ventral nuclei of the lateral fillet fibres pass to the posterior longitudinal bundle of the opposite side, forming a link with oculo-motor nuclei and the motor nuclei of the cord. Some of these centrifugal fibres from the colliculus carry on to the superior olive.

Mixed up in the striae acousticae with these fibres are also fibres going to and coming from the nuclei of the cerebellum. The consideration of these is best deferred until the course of the fibres of the vestibular branch has been described.

THE VESTIBULAR PORTION OF VIIITH NERVE

The vestibular nerve is the proximal and ventral and mesial branch of the octavus. It carries fibres from the semicircular canals, the utriculus and the anterior part of the sacculus. It passes into the medulla below the ventral nucleus of the VIIIth to which it sends fibres. Some fibres also pass directly into the trapezoid body, but the main bulk of fibres pass between the corpus restiforme and spinal tract of the Vth to reach the nucleus triangularis. At the level of the corpus juxta-restiforme a number of fibres turn sharply downwards to form the descending root of the VIIIth and these are accompanied by the nucleus triangularis and can be traced as far down as the level of the nuclei gracilis and cuneatus. Another group of cells also accompanies this descending tract, the nucleus of the descending root.

An ascending root can also be traced to a group of oval or round cells in the lateral wall of the IVth ventricle, the nucleus of Bechterew.

The primary nuclei of the vestibular branch are the ventral nucleus of the VIIIth, the triangular nucleus and the nucleus of Bechterew. With regard to this last nucleus, while most authors regard it as one of the primary nuclei of reception of afferent fibres of the VIIIth, there is much evidence in favour of looking on it as a nucleus for efferent fibres of an autonomic nature. The importance of the autonomic control in a system whose recepts depend on variations in fluid pressure must be fully recognized. The mechanism for maintaining the balance of pressure between the endolymph and the perilymph must be of the most delicate description and the importance of this demands a well-developed autonomic centre. Winkler regards Bechterew's nucleus as the centre for autonomic control and its position in regard to the walls of the IVth ventricle and the shape of its cells are points in favour of its relationship to the intermedio-lateral tract in the cord. Paul van Gehuchten, on the other hand, follows most of the older authorities in regarding Bechterew's nucleus as a primary afferent nucleus of the vestibular system and places the autonomic control in a nucleus lying close to the raphe inside the fibres of the VIIth as they pass up to the genu.

CONSTITUTION OF VENTRO-LATERAL PORTION OF OCTAVO-MESENCEPHALIC TRACT (Diag. III)

We have seen that the ventral nucleus (cochlear nucleus of many authors) receives fibres from both roots of the nerve and also probably gives rise to efferent autonomic fibres. We have already traced the course of the fibres which pass from it into the striae acousticae. We must now trace the fibres which pass down and in from it to form the main part of the trapezoid body and the ventro-lateral portion of the octavo-mesencephalic tract. Into the trapezium there also enter direct fibres from both branches of the nerve. In describing the dorso-mesial portion of the lateral fillet, we found no intercalated nuclei between the primary nuclei and the posterior colliculus and the mesial geniculate. In this other portion of the octavo mesencephalic tract, however, we find several important intercalated nuclei and only a few of the fibres reach the posterior colliculus. The first nuclei met with are the nuclei of the corpus trapezoides, lateral and mesial. The direct radicular fibres end in the mesial nucleus. Those which have been relayed in the ventral nucleus end in the lateral nucleus. These nuclei seem to be only a relay on the way to the superior olive and they are connected up with trapezoidal fibres, both crossed and uncrossed. The main

Labyr. and Neck Reflex Paths
to Oculo Mot. Nuclei in Apes.

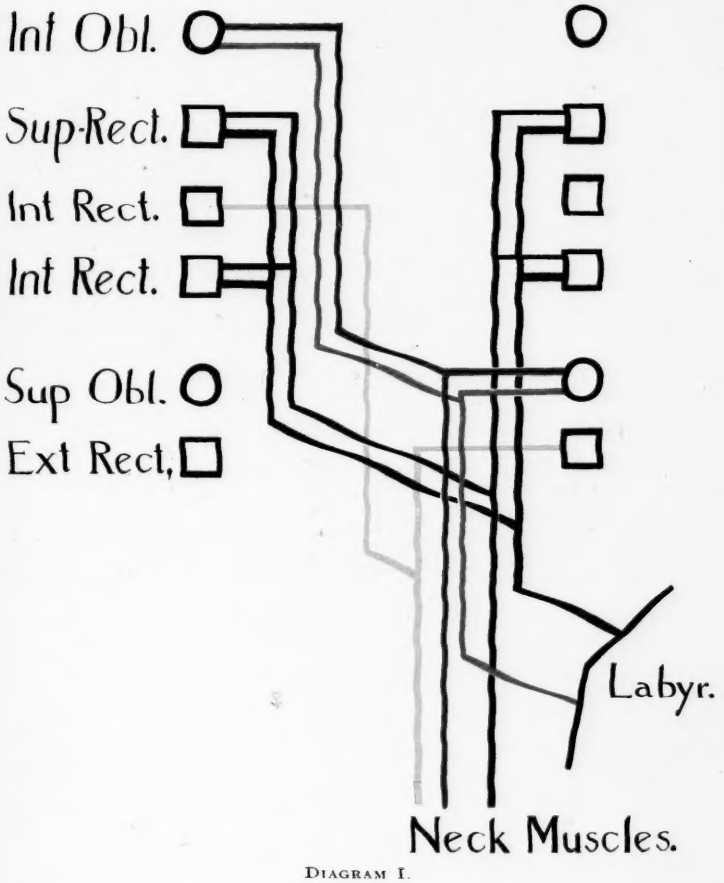

DIAGRAM I.

UNIV. OF MICH.

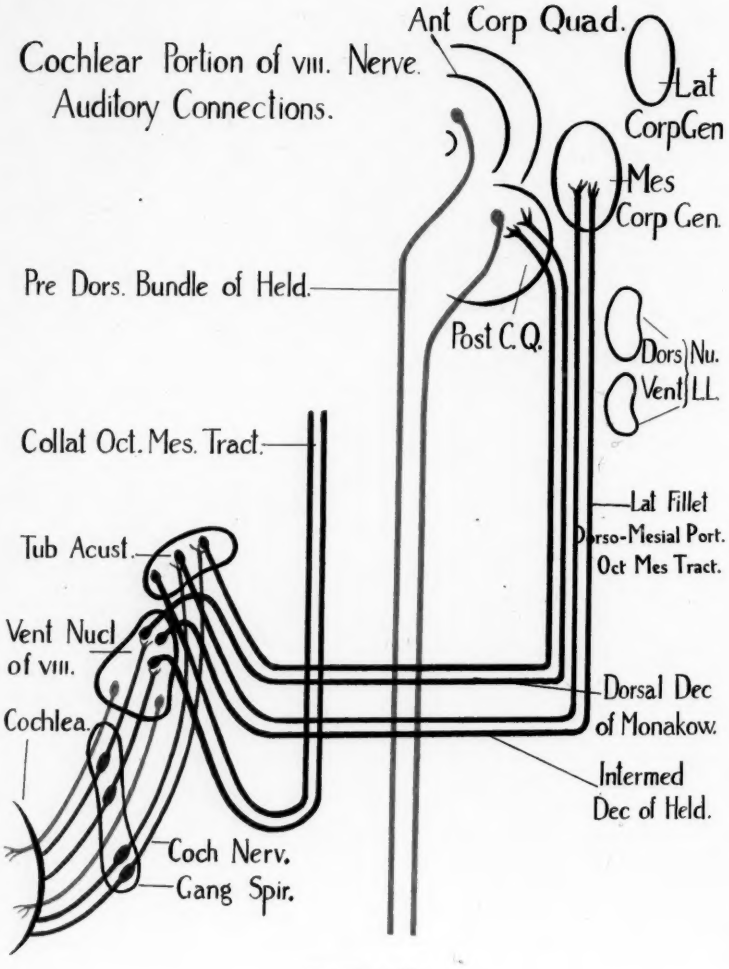
Ant Corp Quad.
Cochlear Portion of VIII. Nerve.
Auditory Connections.
Lat
CorpGen
Mes
Corp Gen.
Pre Dors. Bundle of Held.
Post C.Q.
Dors Nu.
Vent LL.
Collat Oct. Mes. Tract.
Lat Fillet
Dorso-Mesial Port.
Oct Mes Tract.
Tub Acust.
Vent Nucl
of VIII.
Cochlea.
Dorsal Dec
of Monakow.
Intermed
Dec of Held.
Coch Nerv.
Gang Spir.

DIAGRAM II.

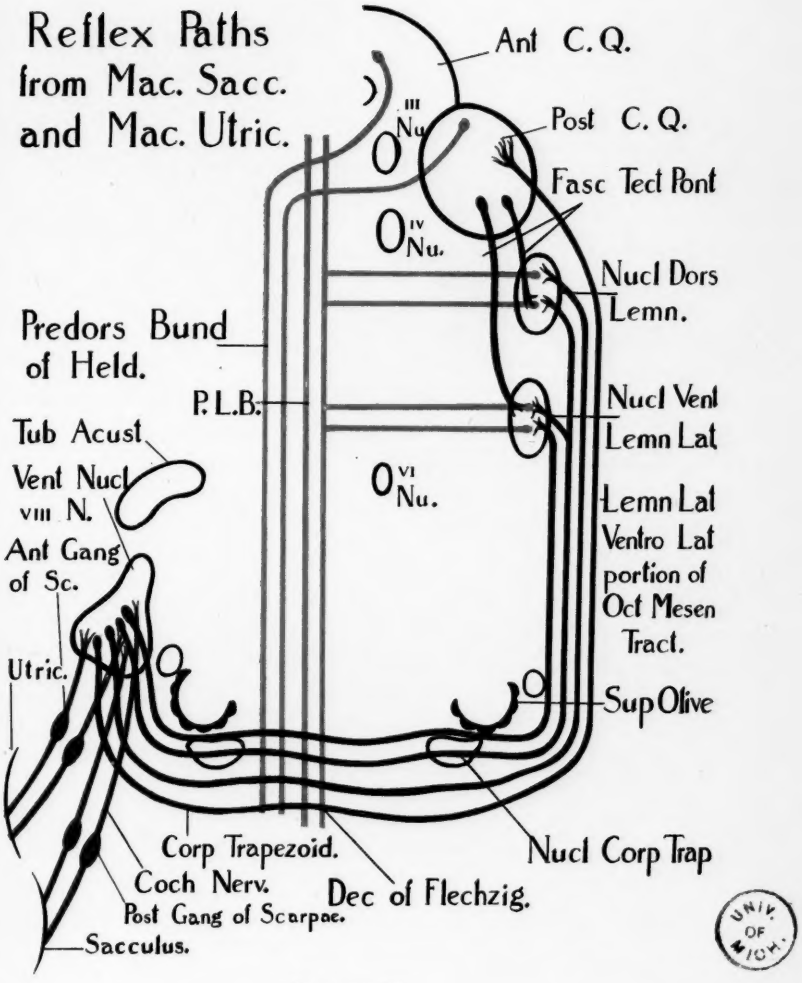

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DIAGRAM III.

Connections of Superior Olive.

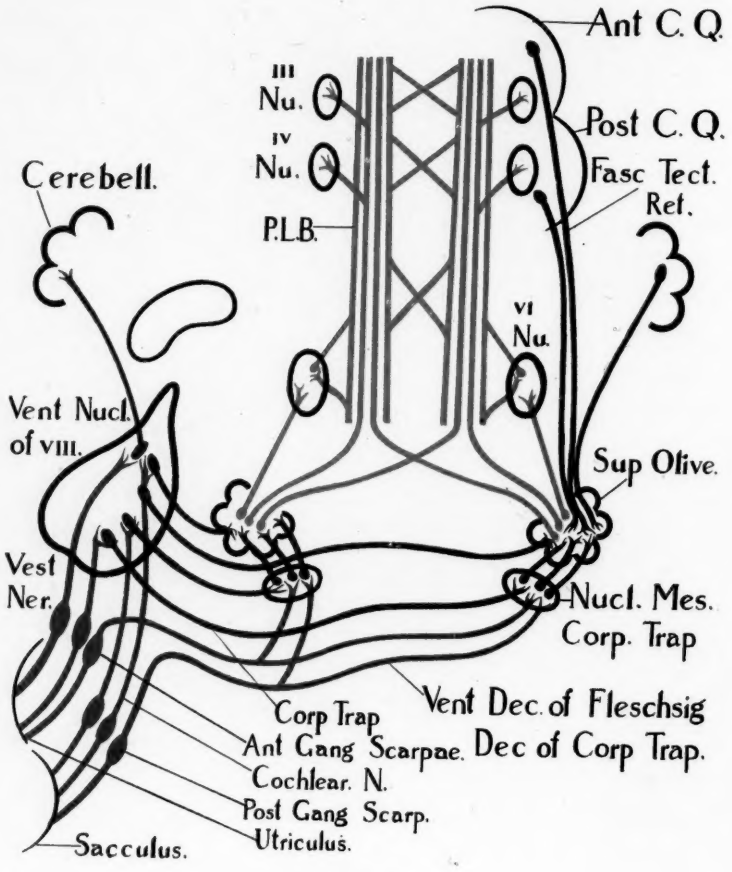

DIAGRAM IV.

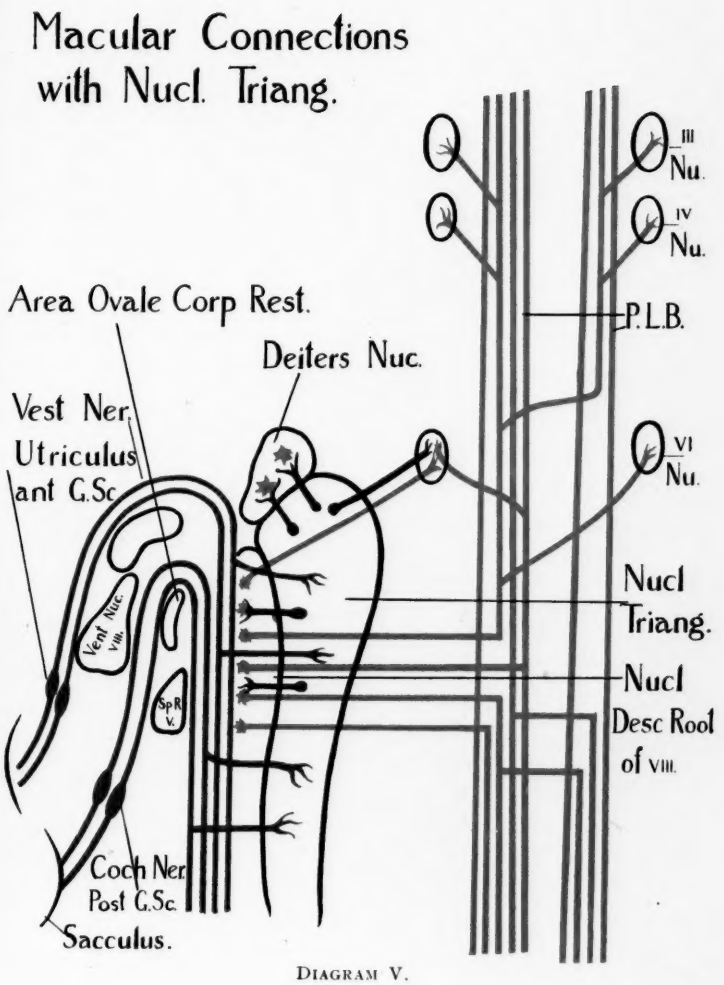

DIAGRAM V.

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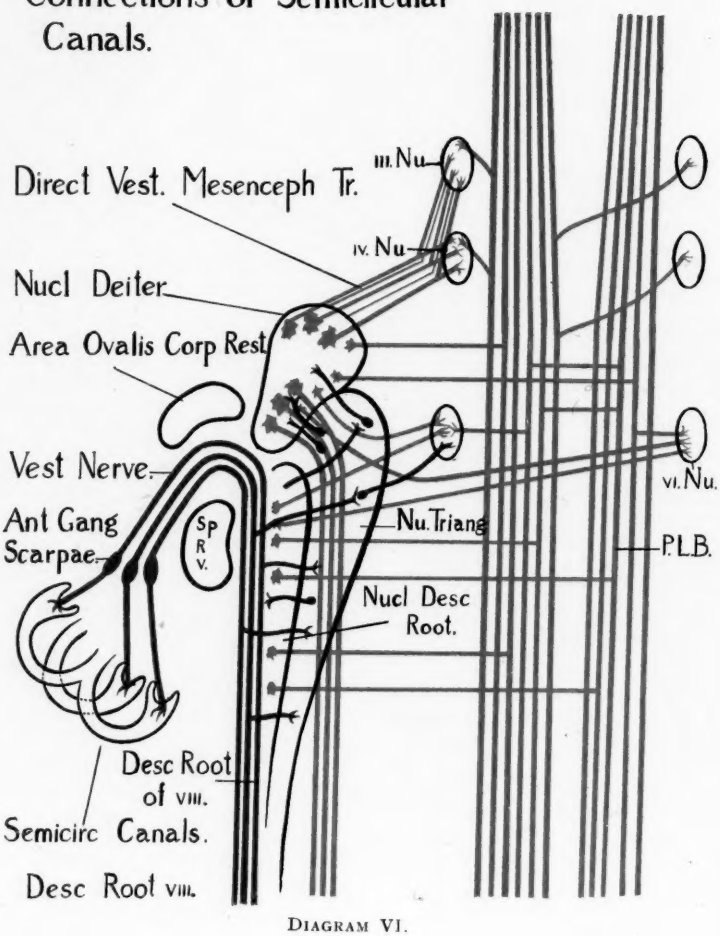
Connections of Semicircular Canals.
Direct Vest. Mesenceph Tr.
III. Nu
IV. Nu
Nucl Deiter
Area Ovalis Corp Rest
Vest Nerve
Ant Gang Scarpae
Sp R V.
Nu. Triang
P.L.B.
VI. Nu.
Nucl Desc Root.
Desc Root of VIII.
Semicirc Canals.
Desc Root VIII.

DIAGRAM VI.

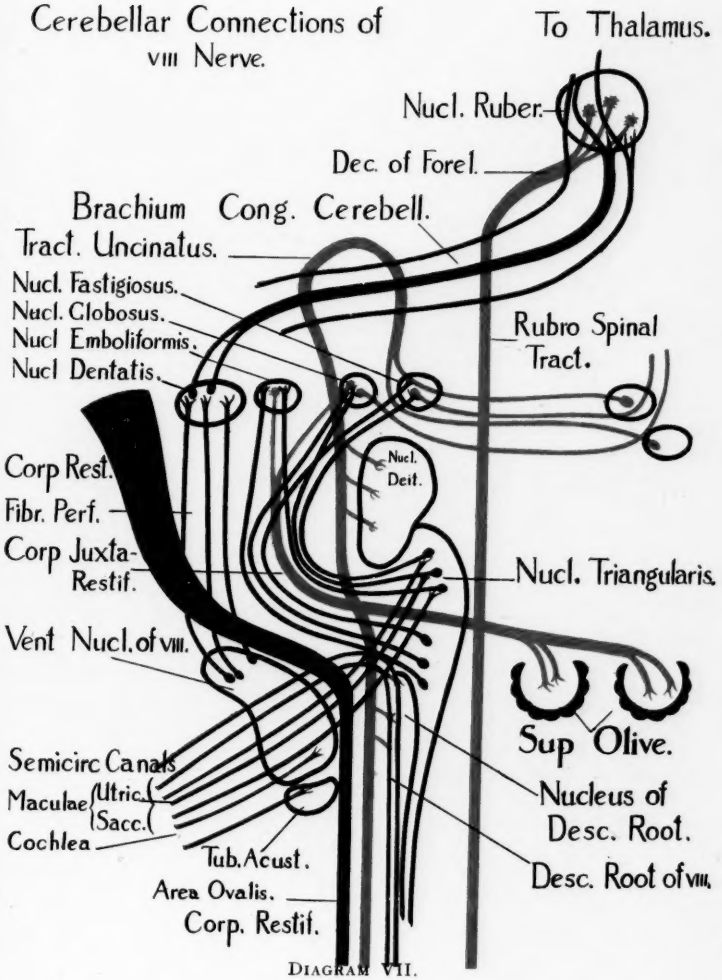

DIAGRAM VII.

UNIV. OF MICH.

bulk of the fibres cross at the decussation of Flechzig and form the ventro-lateral portion of the lateral fillet. On this there are two nuclei, the ventral and dorsal nuclei of the lateral fillet, in which many of the fibres of this part of the tract end. A few pass on to the posterior corpus quadrigeminum. The nerve fibres arising from the nuclei of the fillet pass inwards towards the raphe and help to build up the posterior longitudinal bundle, both crossed and uncrossed, and so form one of the links in the reflex chain between the labyrinth on the one hand, and the oculo-motor nuclei and the anterior horn cells of the spinal cord, on the other. Both nuclei also receive fibres from the posterior colliculus.

CONNECTIONS OF SUPERIOR OLIVE (Diag. IV)

Closely connected with the trapezium is the superior olive. Great variations are found in the development of this structure. In man, it is insignificant in its development, but in animals where the labyrinthine control of ocular movements is predominant, the superior olive is fully developed. Its importance as a co-ordinating centre in these animals is shown by the number of different parts from which it receives fibres:—

1. Secondary fibres from the ventral nucleus of the VIIIth, both crossed and uncrossed.
2. Secondary fibres from the mesial nucleus of the trapezoid.
3. *Tecto-reticular* fibres from the anterior corpus quadrigeminum linking up with the optic system, and from the posterior corpus quadrigeminum linking up with the acoustic system.
4. Kinaesthetic impulses from the spinal root of the Vth by a path which passes into the trapezoides.
5. An important bundle of fibres from the collateral lobe of the cerebellum.

Of the fibres passing out from it, some pass directly to the VIth nucleus of the corresponding side. Others pass in an ascending direction to the posterior longitudinal bundle of both sides, and so link the superior olives with all the oculo-motor nuclei of both sides.

The function of the superior olives would seem to be to collate auditory, gravistatic, gravikinetic, kinaesthetic and ocular impressions and utilize them in the control of eye movements. In cases of complete anophthalmos, no cells are found in the superior olives.

CONNECTIONS OF NUCLEUS TRIANGULARIS AND NUCLEUS OF DESCENDING ROOT (Diag. V)

The nucleus triangularis is the most important primary nucleus of the vestibular branch. It lies in the floor of the IVth ventricle, ventral to the nucleus of Bechterew and between it and the genu of

the VIIth. At this level it is at its broadest and it tails off distally, reaching to the level of the nuclei gracilis and cuneatus. At its distal end, it forks, and the mesial fork lying close to the nucleus of the XIIth is called the nucleus intercalatus. It is accompanied on its outer side by the nucleus of the descending root. It probably gives some direct fibres to the nucleus of the VIth lying closely mesial to it at its proximal end, and to the nucleus of the XIIth at its distal end, and also to nucleus prepositus, but, in the main, it is a relay station on the way to the secondary nuclei, the nucleus of the descending root, Deiter's nucleus and the nuclei in the base of the cerebellum.

The nucleus of the descending root also receives fibres from the cerebellar nuclei. These we shall leave till later, when we can deal with the cerebellar connections in general. The emissary fibres from the nucleus of the descending root, apart from a few which pass directly to the VIth nuclei of both sides, pass into the posterior longitudinal bundle, both crossed and uncrossed, and so link up with all the oculo-motor nuclei of both sides and with the motor cells of the anterior horn in the cord.

In all probability, this nucleus forms an important relay on the reflex path linking up labyrinthine recepts with movements of the eyes and of the limb muscles. (The posterior longitudinal bundle and the predorsal bundle of Held are mainly linked with ocular muscles and limb muscles. The Deitero-spinal tract, which we come to anon, links mainly with neck and trunk muscles.)

DEITER'S NUCLEUS AND THE VESTIBULO MESENCEPHALIC AND VESTIBULO SPINAL TRACTS, AND POSTERIOR LONGITUDINAL BUNDLE (Diag. VI)

Deiter's nucleus, from the large size of its cells, forms a fairly conspicuous land-mark in a complex bit of country. It lies in the mesial portion of the corpus juxta-restiformis down from the level of the VIth nucleus to which it sends direct fibres. Its main bulk of entering fibres comes from the nucleus triangularis, but it also receives fibres from the cerebellum. It gives rise to two important direct tracts, the direct Deitero-mesencephalic tract, or vestibulo-mesencephalic tract to the oculo-motor nuclei and the Deitero-spinal tract, or vestibulo-spinal tract, which forms a main link with the neck and trunk muscles. In addition to these two direct tracts, it is the main nucleus of origin of the ascending and descending fibres of the posterior longitudinal bundle, both crossed and uncrossed. In this way, it has a double link with the oculo-motor nuclei by the direct vestibulo-mesencephalic tract and by the posterior longitudinal bundle, and it links up by the Deitero-spinal

tract with the neck and trunk muscles and by the posterior longitudinal bundle with the limb muscles.

CEREBELLAR CONNECTIONS OF VIIITH NERVE (Diag. VII)

We have still left for consideration the cerebellar connections of these various nuclei, which we have only, so far, mentioned incidentally.

From the dorsal portion of the ventral nucleus of the VIIIth and from the nucleus triangularis, fibres pass to the tectal nuclei of the cerebellum. In the main, those from the ventral nucleus of the VIIIth seem to pass to the nucleus dentatus and those from the nucleus triangularis to the other three roof nuclei, emboliformis, globosus, and fastigiosus. From the nucleus dentatus fibres originate which pass into the anterior cerebellar peduncle, the brachium conjunctivum cerebelli, and cross at the decussation of Wernekink. Some of these end in the red nucleus and others pass to the optic thalamus. From the red nucleus, fibres arise which, crossing again at the decussation of Forel, pass into the lateral column of the cord as the rubro-spinal tract.

The close association in position of the red nucleus with the oculo-motor nuclei leads one to surmise that it may have some direct relationship with them. If so, it would be of great interest in correlating some forms of nystagmus with the forms of tremor which result from lesions of the red nucleus. But that is pure surmise, and I do not know of any cases of nystagmus in which the condition of the red nucleus has been examined, nor of any evidence of the surmised connection with the oculo-motor nuclei.

To return to the other cerebellar nuclei; the fibres arising from the nucleus emboliformis pass backwards to the medulla and passing as fibrae perforantes through the corpus juxta-restiforme, reach the superior olive. Of these, we have already spoken and of their importance in animals, where the labyrinthine control of eye movements is predominant. Some fibres also from the nucleus globosus join this same cerebello-olivary tract. The remaining fibres from the globosus and the fibres from the fastigiosus cross the mid-line, turn upwards for a short distance and then hook round the brachium conjunctivum cerebelli and pass backwards into the posterior peduncle of the cerebellum to reach the corpus juxta-restiforme. This tract is the tractus uncinatus of Risien Russell and it links up with the nucleus of Deiters and then forms a descending tract which links with the nucleus of the descending root. With the further connections of these two nuclei, we have already dealt.

I am not going to attempt, at the moment, to trace the cortical

connections, the thalamic connections, the cortico-pontine connections and the ponto-cerebellar connections.

The important point which, alone, can justify my dwelling so much on these complex and, in part, conjectural anatomical descriptions is to show in how many different ways the labyrinthine impulses can reach and affect the oculo-motor controls and how intimately they are linked up with other muscular controls of head, neck, trunk and limbs. It is unnecessary, for my immediate purpose, to discuss the further controls in which a gnostic or more fully epicritic element is involved.

A MORPHOLOGICAL STUDY OF THE LATERAL GENICULATE BODY

BY

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IF, in the brain of a simple type of mammal, the optic tract is followed on its course from the chiasma to the roof of the midbrain, it will be found to extend up along the side of the thalamus and to come into relation here with an ill-defined eminence called the lateral geniculate body. This eminence is a local swelling on the dorso-lateral aspect of the thalamus and, in fresh specimens, is white in appearance by reason of its covering of optic tract fibres.

The lateral geniculate body in mammals is one of the main terminal centres of the optic tract and is to be regarded fundamentally as a group of cells differentiated from the main mass of the diencephalon in association with its retinal connections. In the lowliest vertebrates all the fibres of the main part of the optic tract are believed to terminate in the midbrain, but, even in these forms, collaterals of these mesencephalic fibres branch off to end in the optic thalamus. Thus it may be said that in all vertebrates the thalamus is concerned to a greater or lesser degree with the direct reception of visual impulses and, indeed, such a conclusion is to be anticipated from a consideration of the diencephalic origin of the retina and optic nerve and tract in the course of embryological development.

The basic structure of the lateral geniculate body in mammals may best be understood from a section taken through this structure along the line of the optic tract in the brain of a simple insectivore, and such a section is illustrated in Fig. 1, which is taken from the brain of *Macroscelides*, one of the small elephant shrews.

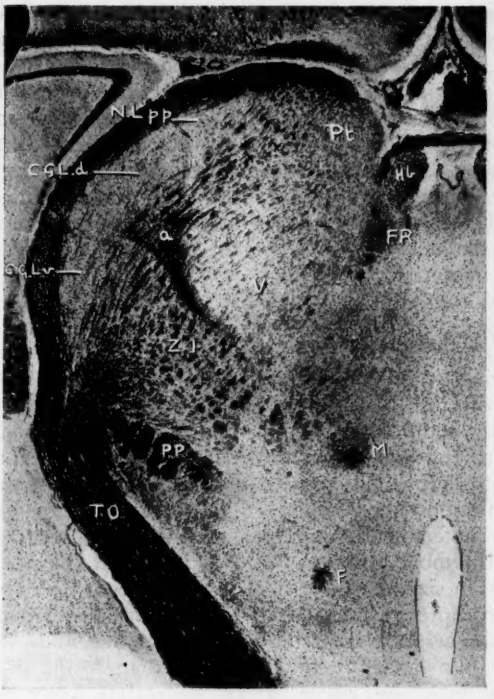


FIG. 1.

Transverse section through the thalamus of the Elephant Shrew (*Macroscelides*), showing the relations of the lateral geniculate body in a primitive insectivore.
C.G.L.d. Dorsal nucleus of lateral geniculate body. C.G.L.v. Ventral nucleus of lateral geniculate body. **a.** Fibre tract connecting the dorsal nucleus of the lateral geniculate body with the ventral nucleus of the thalamus. F. Fornix. F.R. Fasciculus retroflexus. Hb. Habenular ganglion. M. Mammillo-thalamic tract. N.L.p.p. Pars posterior of lateral nucleus. Pt. Pretectal nucleus. P.P. Pes pedunculi. T.O. Optic tract.

Here it can be seen that the lateral geniculate body is made up of two distinct nuclei, a dorsal and a ventral.* These nuclear elements are separated by a thin medullary lamina and are characterised by the different type of their constituent cells as well as by their fibre connections. In general, the ventral nucleus is found to consist of small cells irregularly scattered among the entering fibres of the optic tract, while the dorsal nucleus contains larger cells which

* Kölliker was the first to divide the mammalian lateral geniculate body into dorsal and ventral nuclei.

show a tendency to assume a laminated or stratified arrangement that becomes extremely well-marked in the brains of higher mammals. Weigert preparations of normal brains, as well as a study of Marchi degeneration after section of the optic nerve [21, 3, 4, 9], demonstrate clearly enough that retinal fibres make direct connections with both dorsal and ventral nuclei. From Cajal's researches[6], it is probable that only collaterals of the optic tract fibres terminate in the ventral nucleus, and herein the ventral nucleus of the mammalian lateral geniculate body is comparable with the thalamic optic centre of lowly vertebrates. Cajal also described in detail the manner in which the entering optic fibres are related to the dorsal nucleus. He showed that in relatively simple types, *e.g.*, rodents, a large proportion of the optic fibres penetrate the dorsal nucleus from the lateral aspect (some, however, also entering from the ventral pole). The general position and relations of the two nuclei of the lateral geniculate body in generalised mammalian brains may be readily understood by reference to the diagrams shown in Fig. 2, which represent these two elements projected on the lateral aspect of the thalamus. The nuclei may most conveniently be considered separately, but it should be noted at this juncture (1) that the ventral nucleus is evidently the more primitive optic centre, for it shows a progressive diminution in size as it is traced through a comparative anatomical series from more generalised to more highly developed types, and (2) that concurrently with the increase in size and elaboration of other thalamic nuclei in higher mammalian forms (especially the lateral nucleus), the whole lateral geniculate body becomes displaced from a lateral to a ventral position and this displacement is associated with a certain degree of rotation.

The Ventral Nucleus of the Lateral Geniculate Body.—This nucleus lies below and in front of the dorsal nucleus (Fig. 2). It is penetrated by optic fibres from its ventral aspect and many of these fibres pass through it without interruption to reach the dorsal nucleus[26, 9]. One fundamental fact that stands out as a result of a comparative anatomical study of the ventral nucleus of the lateral geniculate body in primitive mammalian brains is that the nucleus is nothing more than a differentiated lateral segment of that part of the *pars ventralis diencephali* which is called the subthalamus. This is indicated in the first place by purely topographical relations and by the fact that the cells are of the same type, for, cytoarchitecturally, the ventral nucleus grades insensibly into the zona incerta of the subthalamus. In such a form as *Macroscelides*, indeed, the ventral nucleus is only to be distinguished from the rest of the subthalamus by the fact that it receives collaterals from the optic tract and that it is incompletely cut off by bundles of fibres which run from the caudal part of the internal capsule to the tectal

region of the brain. This broad continuity of the ventral nucleus of the lateral geniculate body with the subthalamus is also very evident in sections of the developing thalamus of higher mammals. In the adult brains of such forms, however, the association of the ventral nucleus with the zona incerta is not so obvious by reason of the lateral displacement of the former which is partly due to the greater development of the lateral and ventral nuclei of the thalamus. The rich collection of medullated fibres which run medially and caudally from the ventral nucleus into the zona incerta (ventral to

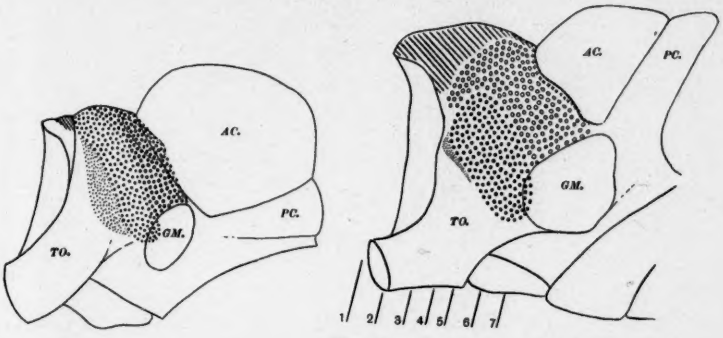


FIG. 2

Lateral view of the thalamus of (A) the Tree-shrew *(Tupaia)*, and (B) *(Tarsius)*. Some of the thalamic nuclei have been projected on to the surface to indicate their relative position and extent. Oblique lines = lateral nucleus, fine dots = ventral nucleus of lateral geniculate body, coarse dots = dorsal nucleus of lateral geniculate body, circles = pars posterior of lateral nucleus (pulvinar), crosses = large-celled nucleus of optic tract.

the ventral medullary lamina of the thalamus) is further evidence of the relation between the two. I have observed this fibre connection in insectivores, and in the primitive Primate, ***Tarsius***.[8] Gurdjian[14] has also noted (in the rat) that the ventral nucleus is in intimate synaptic relation with the zona incerta and he believes that it is likewise associated with Meynert's commissure. Connections have also been described[28] between the ventral geniculate nucleus and the tectal region (superior colliculus and probably also the pretectal nucleus).[9] On the other hand there is no evidence that the nucleus gives off any cortical fibres, and neither does it receive any corticifugal fibres.[2]

From its position, structure and connections, therefore, the ventral nucleus of the lateral geniculate body may be regarded as essentially a subthalamic optic centre with tectal connections. In spite of the latter, it is primarily a dependency of the subthalamus rather than of the tectum, and this is related to the fact that it

retains a closer topographical relation with the subthalamus than with the roof of the midbrain in the displacements which occur as the result of differential developments of other parts of the thalamus.

Since the ventral nucleus of the lateral geniculate body is connected only with relatively low functional levels of the brain and does not give rise to any part of the optic radiations (being, indeed, completely independent of the cortex), it may be expected that in higher mammalian forms in which the activities of the tectal and subthalamic centres become progressively subordinated to those of the telencephalon, the nucleus will become a much less significant structure. This, in fact, is the case. In the brain of the tree-shrew, *Tupaia* (Fig. 2), in which the superior colliculus reaches an immense size, the ventral nucleus of the lateral geniculate body is correspondingly large. In the most primitive lemuroid brain—that of *Microcebus murinus*—(which is readily comparable with *Tupaia*), the midbrain is very much smaller relatively to the cerebral cortex, and the ventral geniculate nucleus, though easily discernible, is much reduced in size.[10] In higher Primates, the nucleus has been stated to be absent altogether, but it is probably usually to be recognised in the form of small cells which are scattered among the fibres of the optic tract as they enter the main part of the geniculate body, and which are sometimes referred to as the pregeniculate nucleus.[28] It may be noted that in these higher forms, as a consequence of the relative displacement of the lateral geniculate body, the ventral nucleus comes to be situated rather anteriorly than ventrally to the dorsal nucleus. It is interesting, also, to note that in the human embryo the ventral nucleus of the lateral geniculate body appears to be as distinct as it is in simple mammalian brains (Fig. 5). A further point about the ventral geniculate nucleus in higher mammals is that it receives only crossed fibres of the optic tract,[3] and this fact again emphasises the primitive character of the ventral as compared with the dorsal nucleus.

The Dorsal Nucleus of the Lateral Geniculate Body.—The dorsal nucleus, in primitive mammalian brains, is made up of the same type of cell as the ventral or main sensory nucleus of the thalamus and is closely applied to the lateral aspect of this nucleus, being separated from it by the lateral medullary lamina which is largely made up of fibres passing between the tectal region and the internal capsule. This topographical relation is also to be found in the thalamus of the human embryo (Fig. 5), and, indeed, comparative anatomical and embryological data indicate that the dorsal geniculate nucleus is to be regarded primarily as the differentiated lateral part of the ventral nuclear mass of the thalamus. This relation is also shown by a consideration of the condition in those insectivores in

which the optic nerves are very poorly developed and the visual cortex but feebly differentiated (*e.g.*, the common shrew, *Sorex*), for, in this form, the dorsal nucleus of the lateral geniculate body appears to undergo retrogressive changes and to become merged indistinguishably again with the ventral thalamic nucleus. Further, an analogy based upon functional level is indicated by the fact that the dorsal geniculate nucleus bears the same relation to visual impulses passing through the thalamus to the cortex as does the ventral nucleus of the thalamus to somaesthetic impulses. If the dorsal nucleus of the lateral geniculate body, then, is formed by the splitting off of the lateral part of the ventral thalamic nucleus, it may be expected to retain its connection with this nucleus by fibre connections. In small mammalian brains in which the lateral geniculate body, though completely differentiated, remains still of a simple type, such a connection is easy to see, and abundant medullated fibres can be traced emerging from the medial aspect and passing medially into the ventral thalamic nucleus. In brains like that of *Macroscelides* (Fig. 1) and the fruit bat, *Pteropus*, in which, while the optic tracts are of a large size, the visual cortex is still comparatively poorly differentiated, this intrathalamic connection of the dorsal geniculate nucleus is very striking. In an animal like the Virginian opossum, in which the optic system is not very strongly developed, the connection is only feebly indicated,[26] and in higher forms where rich geniculo-cortical connections (optic radiations) are developed in association with a progressive elaboration of the visual cortex, these intrathalamic connections also become less evident.

It has been shown that the ventral geniculate nucleus is connected by fibre paths with the superior colliculus. It is probable that such a connection also exists in regard to the dorsal nucleus. This, however, is not easily proved by ordinary degeneration experiments for the reason that the tectal fibres from the ventral nucleus largely pass through or in very close relation with the dorsal nucleus. However, in normal Weigert preparations, fibres may be observed leaving the lateral margin of the dorsal nucleus to join the optic tract as it runs on towards the roof of the midbrain. These fibres are probably destined to reach the superior colliculus and the pretectal nucleus, and perhaps also the pars posterior of the lateral nucleus or pulvinar.*

The dorsal nucleus of the lateral geniculate body is interconnected by short fibres with the neighbouring part of the pars posterior of the lateral nucleus. This fibre connection is readily to be seen in simple types of brain in which the lateral geniculate body preserves its simple form and is not encapsuled by a dense feltwork of

* For a discussion of the homologies of the pulvinar and the pars posterior of the lateral nucleus, see[9].

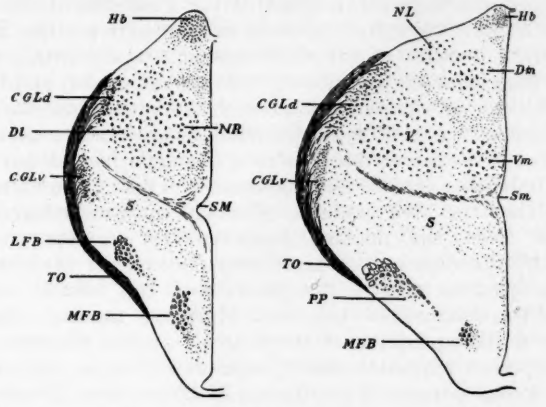
medullary fibres. The most significant fibre connections of the dorsal nucleus in higher mammals are those which run between it and the occipital cortex in both directions. These corticipetal fibres form the optic radiations. They are composed of the axons of the cells of the dorsal nucleus which emerge from the medial surface of the nucleus (or from the dorsal surface in the brains of more advanced types in which a rotation of the lateral geniculate body has occurred) and, coursing through the posterior part of the internal capsule, terminate in the area striata or visuo-sensory cortex.

The Evolution of the Lateral Geniculate Body in the Lower Vertebrates.—Having considered the main features of the lateral geniculate body in generalised mammalian brains, it is convenient to trace its evolutionary origin from that of submammalian forms. The general opinion obtains that the tectum of the midbrain is the primitive termination of the optic tract and that, with the gradual process of prosencephalisation, the main visual centres shift forwards gradually to the forebrain. This is in general true, but the fact remains that the retina develops as an appendage of the thalamic part of the brain tube in the embryo and, as we pointed out above, it is therefore to be expected that the diencephalon would be associated from the first with the reception, in part at least, of visual impulses. Actually in all vertebrates studied to this end optic fibres can be traced into the diencephalon, though the majority do terminate in the midbrain in the most primitive forms. Even in the lamprey, a cyclostome, in which the midbrain had been regarded as the sole terminal station for the visual impulses, collaterals of optic tract fibres have been demonstrated to end in a group of cells in the lateral wall of the diencephalon.[23]

As far as amphibia are concerned, in the frog,[13, 27] the optic tract after decussation and sending off a basal bundle (*vide infra*) passes up the side of the thalamus to reach a superficial collection of cells which has been called the lateral geniculate body, and further dorsally it sends collaterals to another nucleus which Wlassak and Bellonci named the nucleus antero-superior of the lateral geniculate body. Herrick[15] failed to find in *Necturus* a differentiated nucleus corresponding to Wlassak's lateral geniculate body (perhaps because in this urodele the optic system is poorly developed), but he found a fairly well-differentiated thalamic centre apparently homologous with the nucleus antero-superior of Bellonci[1] and Wlassak.[27] This centre Herrick calls the *pars optica thalami*, and it is to be regarded as essentially a differentiated part of his *pars dorsalis thalami*. Since the latter element in the amphibian brain is the great somatic sensory receptive centre of the diencephalon, its homologue in the mammalian thalamus is undoubtedly to be found in the ventral group of nuclei. It seems probable, therefore, that the *pars optica thalami* of Herrick is the primordium of the dorsal nucleus of the

lateral geniculate body of mammals (which, as pointed out above, is formed as a differentiation of the ventral thalamic nucleus). If this is so, the "lateral geniculate body" described in some amphibia probably represents the ventral nucleus of the mammalian lateral geniculate body. This interpretation brings the amphibian optic centres into line with those of the reptilia.

A lateral geniculate body in the reptilian brain has been described by many investigators[1, 5, 11, 12, 16, 18, 20]. It forms (in transverse sections



A. FIG. 3. B.

Schematic representations of transverse sections through the thalamus of (A) Reptilian brain, and (B) Mammalian brain, showing the homologies of certain diencephalic elements.
C.G.L.d. Dorsal nucleus of lateral geniculate body. C.G.L.v. Ventral nucleus of lateral geniculate body. Dl. Nucleus dorso-lateralis anterior. Dm. Dorso-medial nucleus. Hb. Habenular ganglion. L.F.B. Lateral forebrain bundle. M.F.B. Medial forebrain bundle. N.L. Nucleus lateralis. N.R. Nucleus rotundus. P.P. Pes pedunculi. S. Subthalamus. S.M. Sulcus medius. T.O. Optic tract. V. Ventral nucleus. Vm. Nucleus medio-ventralis.

of the thalamus) a vertical band of cells lying on the lateral surface of the diencephalon and is reached by the optic tract which splits into two branches to enclose it on its lateral and medial aspects. It is to be noted that, before it has reached the geniculate body, the optic tract has already given off a basal root to the basal optic ganglion (nucleus ectomammillare) and, according to some observers such as Bellonci, fibres to the subthalamic region (representing the axillary bundle described in amphibia by Wlassak and Herrick). These two roots are apparently equivalent to the anterior and posterior accessory optic tracts of mammals (see[9, 26]). The next nucleus to be reached by the optic tract as it courses dorsally in

mammals is the ventral necleus of the lateral geniculate body. From its position in the course of the optic fibres, therefore, the lateral geniculate body of reptiles appears to be the homologue of the mammalian ventral geniculate nucleus. This identification is confirmed by other considerations. The reptilian lateral geniculate body receives mainly, if not entirely, collaterals of the optic tract fibres, as does the ventral geniculate nucleus of mammals. Topographically, the body is related medially to a collection of cells which has been called the "area triangularis"[16, 11] and, in fact, the cells of this area merge with those of the geniculate body without any clear limits. Now, by its general relations, its position in regard to the sulcus medius of the third ventricle, and by its continuity with the *area ventralis anterior* of Huber and Crossby, and Durward (which is itself continuous behind with the entopeduncular nucleus and in front comes into synaptic relations with fibres of the stria terminalis), it is evident that this area triangularis is a part of the pars ventralis diencephali (subthalamus). This is also indicated by the fact that the area contains olfactory projection tracts and is separated from the nucleus dorso-lateralis anterior (a somatic nucleus) by the diencephalo-periventricular system of fibres which seems in part to occupy the position of the ventral medullary lamina of the mammalian thalamus. Moreover, the area triangularis seems to be the equivalent of the diffuse "ventral thalamic nuclei" of the reptilian thalamus which were described by de Lange (*cf.* figures in the papers of de Lange,[20] Huber and Crossby,[16] and Durward[11]) and a part of which this author identifies as the homologue of Field H of Forel (of the mammalian subthalamus). It therefore appears that the lateral geniculate body in reptiles, as it has been generally described, bears the same topographical relation to the reptilian equivalent of the subthalamus that the ventral nucleus of the lateral geniculate body does to the subthalamus in mammals. A consideration of the fibre connections leads to the same interpretation. Three main fibre connections have been described for the reptilian lateral geniculate body—a *fasciculus geniculatus descendens*, a *tractus geniculo-pretectalis*, and a *tractus geniculo-tectalis*. The first has been described by Beccari and Huber and Crossby, and was traced by them into the posterior part of the subthalamic region. A tract described in the chamaeleon by Shanklin,[24] and called by him the *tractus geniculo-hypothalamicus*, is clearly the same connection. In this reptile, in which the optic mechanism is unusually well-developed, it could be traced as a broad band of fibres spreading over most of the area between the nucleus rotundus dorsally and the ventral peduncle of the lateral forebrain bundle ventrally, many of the fibres terminating in hypothalamic nuclei.

This subthalamic connection of the reptilian lateral geniculate

body, as well as its connections with the tectum, clearly corresponds very well with the fibre connections of the ventral nucleus of the lateral geniculate body of mammals, and finally establishes the homology of these structures. The geniculo-pretectal tract of reptiles probably represents the tract of the same name in mammals though, in the latter, it has not been certainly demonstrated (except on the basis of such an analogy) whether the ventral or the dorsal nucleus gives origin to this connection. The question now arises as to whether there is any equivalent of the dorsal geniculate nucleus of mammals in the reptilian thalamus. It has been suggested by some authorities that this is not to be expected seeing that the dorsal nucleus is essentially the nucleus of origin of the cortical optic radiations, and no visual cortex has been demonstrated to exist in the reptilian cerebrum. But the dorsal geniculate nucleus has intrathalamic connections with the ventral thalamic nucleus which are especially rich in certain primitive mammals and which presumably anticipated in evolutionary development, the cortical connections. It has already been shown that the dorsal nucleus in mammals is differentiated out of the ventral nucleus of the thalamus—the main somatic sensory nucleus of the diencephalon. Huber and Crossby state that in the crocodile the optic tract, after passing by the lateral geniculate body, comes into relation with the nucleus dorso-lateralis anterior in the lateral part of which some optic fibres actually terminate. Now there is little doubt that the nucleus dorso-lateralis anterior of reptiles is to be regarded as homologous with a part of the ventral thalamic nuclear group of the mammalian thalamus and, this being so, the relation of its superficial cells to terminal optic fibres almost certainly indicates that they represent the undifferentiated *anlage* of the dorsal geniculate nucleus. Moreover, in some reptiles at least (e.g., Sphenodon), these superficial cells become differentiated to form a fairly circumscribed nucleus which has been termed the dorsal nucleus of the lateral geniculate body by some authors.[11,5] The relative position of this nucleus in regard to the optic tract and to other thalamic elements provides considerable justification for this nomenclature. There is in Sphenodon also a ventral nucleus of the lateral geniculate body which, as Cairney indicates, corresponds with the area commonly termed the lateral geniculate body in other reptiles, and it is this element which gives off the fasciculus geniculatus descendens.

The homologies of the lateral geniculate body in reptilians and mammals are illustrated diagrammatically in Fig. 3.

The Evolution of the Lateral Geniculate Body in Mammals.—An account has been given of the structure and connections of the lateral geniculate body in a primitive and generalised mammalian brain. As may be readily apprehended from the reconstructions

figured (Fig. 2), the lateral geniculate body in such a form stretches obliquely downwards and backwards along the whole extent of the lateral aspect of the thalamus from its anterior to its posterior limits. The relatively large size of the body in primitive insectivores (in relation to the size of the thalamus as a whole) and its extension forwards should be noted, for some observers have expressed surprise that the lateral geniculate body in reptiles reaches to the anterior part of the thalamus. The primitive position of the body becomes considerably altered in higher mammals, principally as the result of the development of adjacent thalamic nuclei. Thus its caudal part becomes first displaced more ventrally (in association with an enlargement of the pulvinar or pars posterior of the lateral nucleus), and subsequently, as a direct result of the increasing elaboration of the main lateral thalamic nucleus, the whole lateral geniculate body is pushed down so that it comes to lie on the ventro-lateral aspect of the thalamus. Further, as we shall see below, this displacement is also associated with a rotation and, in the higher Primates, with a bending of the lateral geniculate body on itself.

It has been pointed out by several observers[28, 17] that the dorsal and ventral nuclei show an inverse ratio in their development in higher mammals, and this is precisely what is to be anticipated from a consideration of their early phylogenetic history and their connections. The ventral geniculate nucleus is the more primitive element and, as a dependency of the subthalamus with tectal connections, it becomes progressively superseded by the dominance of the dorsal nucleus with its cortical connections. But even in the simplest mammalian brains the dorsal nucleus is distinctly larger than the ventral nucleus. The fate of the ventral nucleus has been dealt with above. The most important diencephalic centre of vision in reptiles is destined to be reduced in higher mammals to an insignificant collection of scattered cells which lie among the fibres of the optic tract entering the elaborate dorsal nucleus, which, in the larger Primates, constitutes what is now called the pregeniculate nucleus or the *corpus pregeniculatum*.

The fate of the dorsal nucleus of the lateral geniculate body in the higher mammalian series is a history of progressive elaboration which proceeds *pari passu* with the development of the visual cortex of the cerebrum. Disregarding the divergent mammalian groups such as the ungulates and carnivora, the changes which occur in the transition from the simple form of the dorsal nucleus of the lateral geniculate body of primitive mammals to the complicated structure found in higher Primates may best be illustrated by the consideration of a series of animals which—as indicated by detailed comparative anatomical studies—most closely approximate to a true phylogenetic series in the evolution of the higher Primates. In a generalised insectivore such as the hedgehog the dorsal nucleus

appears in transverse section as a lens-shaped group of cells closely applied to the subjacent ventral thalamic nucleus, and lying rather on the dorso-lateral aspect of the thalamus. There is here no differentiation in the internal structure of the dorsal nucleus.

Fig. 4.

Transverse section of the lateral geniculate body of the Tree-shrew (*Tupaia minor*).
C.G.L.d. Dorsal nucleus of lateral geniculate body. N.L.p.p. Pars posterior of lateral nucleus. T.O. Optic tract.

Optic tract fibres enter from the lateral aspect and to some extent at the ventral border. In *Tupaia minor* (the lesser tree-shrew), an insectivore with a number of singularly primate-like characters, the dorsal nucleus is much larger and, moreover, its cells show a definite tendency to a laminated arrangement. The cells of the lateral and medial laminae are conspicuously larger than those in the centre of the nucleus. The increase in size and the incipient

differentiation in internal structure of the dorsal nucleus of the lateral geniculate body in *Tupaia* is associated with the high grade of development of other elements of the visual apparatus of the brain, *e.g.*, the large optic nerves, the relative size of the pulvinar, and the extent and differentiation of the visual cortex. It is interesting to note that in the thalamus of the early human embryo the dorsal nucleus of the lateral geniculate body shows a relative

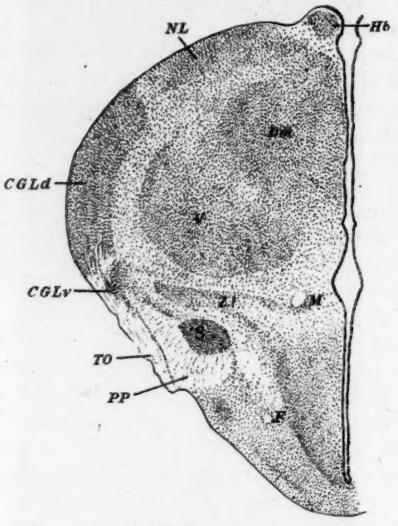


FIG. 5.

Transverse section through the thalamus of a 92 mm. human embryo. C.G.L.d. Dorsal nucleus of the lateral geniculate body. C.G.L.v, Ventral nucleus of the lateral geniculate body. Dm. Dorso-medial nucleus. F. Fornix. Hb. Habenular ganglion. M. Mammillo-thalamic tract. N.L. Nucleus lateralis. P.P. Pes pedunculi. T.O. Optic tract.

size and topographical position which approximates very closely to the condition in an insectivore such as the tree-shrew. The change in the dorsal nucleus of *Tupaia* as compared with that of other insectivores foreshadows the much more striking changes to be found in the Primates. In some of the most primitive forms of this group there seems to be little advance on the condition found in the tree-shrew. In *Cheirogaleus*, for instance, the dorsal nucleus of the lateral geniculate body has the same position and shape, the only important difference being a more pronounced lamination of its constituent cells.[19] As in *Tupaia*, the fibres of the optic tract enter the nucleus largely from its lateral aspect, and

the optic radiations emerge from its medial concave surface. In Fig. 6 is shown the appearance of a section of the lateral geniculate body in the mouse-lemur (*Microcebus murinus*), one of the most primitive living members of the Primates. Here the lamination and differentiation of the dorsal nucleus is more obtrusive. It will be noted that the lateral laminae consist of much larger cells than those of the medially situated laminae. The appearance of superficial large-celled laminae (one or two) is a characteristic feature of the lateral geniculate body of Primates, and so far as is known it is conspicuously present in every Primate with the curious exception of *Tarsius*.[8] The further changes which occur in the dorsal nucleus in higher Primates (besides the displacement of the nucleus as a whole) are a result of the folding of these laminae and their cytoarchitectural differentiation.

In all monkeys (even in relatively simple types such as the marmoset) the laminae have become completely everted. This change is best understood by reference to Fig. 6. As a result of this eversion, a definite hilum is formed, directed ventro-medially, and it is from this direction that optic tract fibres (as well as branches of the posterior cerebral artery) enter the nucleus. At the same time the medial laminae are curved so as to form a dorsal convexity from which the optic radiations emerge. This process of eversion is evidently associated with and provides for an expansion of the more medially situated cell laminae and it is interesting to note that it is these medial laminae which are related to the binocular type of vision which attains such a high degree of development among the Primates.[4] The intermediate steps which culminate in the formation of the completely everted type of lateral geniculate body may be traced in different members of the group of Primates as well as by embryological studies. In man, as in the African anthropoid apes, the eversion is not so complete. A lateral "spur" is left, or, in other words, the original dorsal and ventral margins of the dorsal nucleus of the lateral geniculate body have not become approximated to complete the formation of the hilum. In the orang utan, the dorsal nucleus seems to be remarkably simple (according to Kornyey's description and figure[19]), and the laminae in this ape are but little curved. It is not a little remarkable that, as regards these changes in the lateral geniculate body, the pithecoidea should have advanced further than man and the anthropoid apes (with the significant exception of the gibbon which, in this respect, resembles the monkeys).

A detailed study of the manner in which the laminae of the lateral geniculate body become convoluted in different mammalian groups would no doubt provide interesting and valuable data for the assessment of systematic affinities. This taxonomic aspect of the problem is well illustrated within the limits of the order of Primates

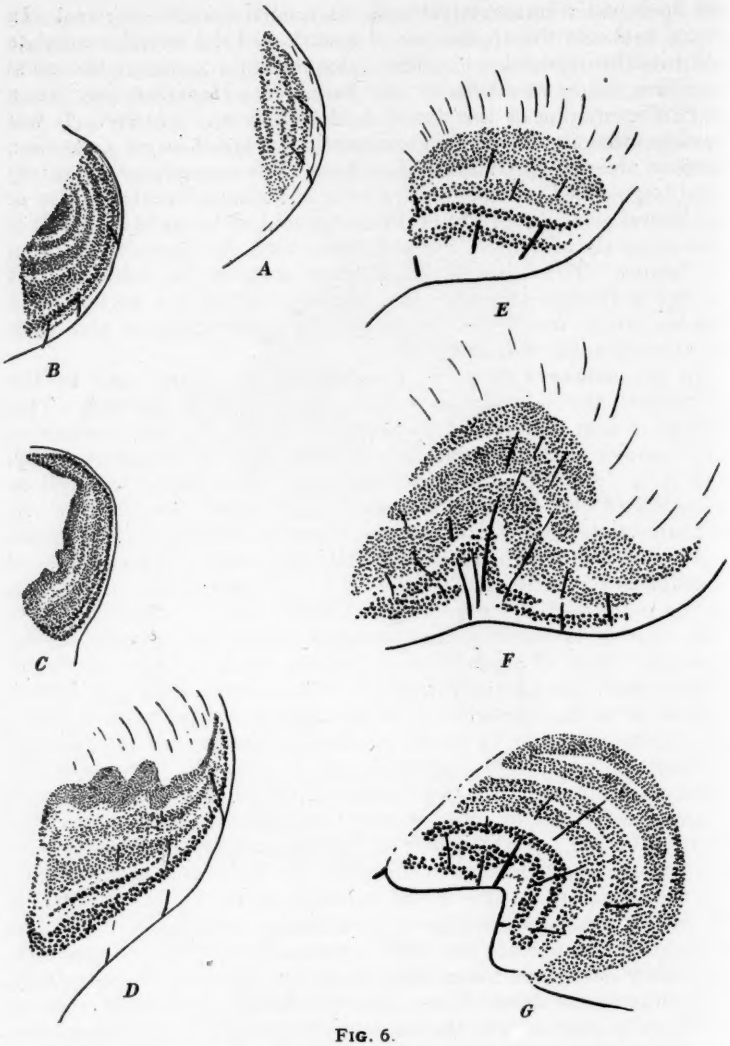


FIG. 6.

The appearance in transverse section of the dorsal nucleus of the lateral geniculate body of (A) Tree-shrew *(Tupaia)*, (B) Mouse Lemur *(Microcebus murinus)*, (C) Coquerell's Dwarf Lemur *(Microcebus Coquerelli)*, (D) *Lemur catta*, (E) Orang utan (after Kornyey), (F) Man, (G) *Cercopithecus*, showing the arrangement of the cell laminae and the direction of the entering blood vessels. The lateral side of the geniculate body is towards the right.

as is indicated in the diagrams in Fig. 6. It will be recalled that systematists generally recognise three suborders of the Primates, *Lemuroidea*, *Tarsioidea*, and *Anthropoidea*. The first includes the true lemurs of Madagascar, the lorises and pottos, the latter includes monkeys, apes, and man, while the suborder *Tarsioidea* is represented to-day by only one genus, *Tarsius*. As regards the first two suborders there have been for many years sporadic discussions, often of an animated and even acrimonious nature, as to the precise nature of the affinities of the *Anthropoidea* with the *Lemuroidea*.

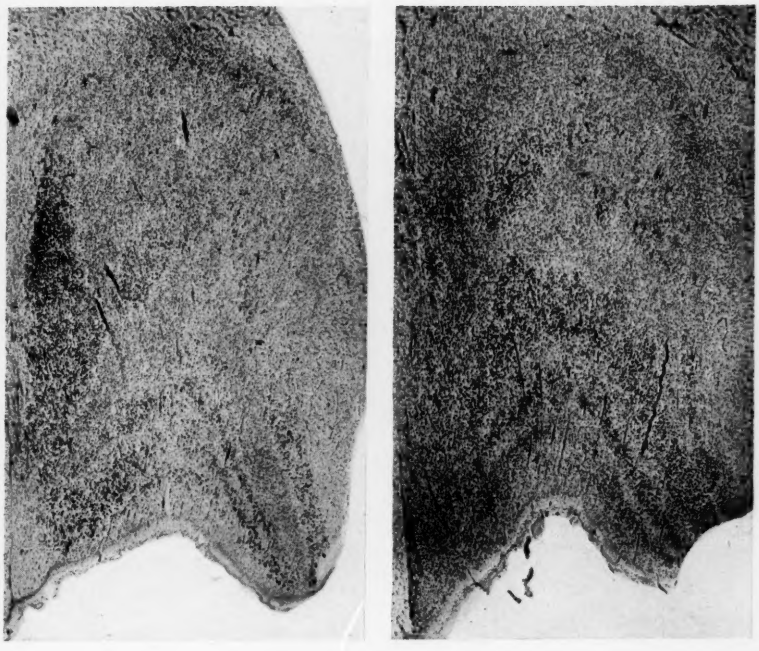
A survey of a graded series of members of the *Lemuroidea* (*e.g.*, the series *Microcebus murinus*, *Microcebus Coquerelli*, *Lemur Macaco*) indicates that in this suborder the laminae of the lateral geniculate body have become progressively folded in a direction quite the opposite of the condition in the *Anthropoidea*. In the mouse-lemur the lamination is particularly distinct, and the laminae show a curvature which is in conformity with the convex lateral surface of the thalamus. In Coquerell's dwarf lemur a tendency is shown towards an incurving of the laminae so that the medial concavity of the geniculate body (from which the optic radiations emerge) is more exaggerated. The medially situated laminae appear to be "buckled up" as the result of this inversion so that it is thrown into a few irregular folds. In *Lemur* this inversion of the laminae is also to be seen, and the medial laminae are more distinctly folded into a series of small undulating convolutions. Also, the whole nucleus has been rotated to some degree so that the lateral surface now is directed ventro-laterally.

Thus, while in the *Anthropoidea* an everted type of lateral geniculate body is developed, with the production of a medio-ventral concavity or hilum at which fibres of the optic tract and branches of the posterior cerebral artery enter the nucleus and a dorso-lateral convexity from which the optic radiations emerge, in the *Lemuroidea* there has been evidently a progressive inversion so that the optic tract fibres and blood-vessels enter from a ventro-lateral convex surface and the optic radiations emerge from an accentuated dorso-medial concavity. In both groups there has clearly been an expansion of the medial laminae which, as we may infer from the experimental reseaches of Brouwer and his colleagues, are predominantly related to the binocular type of vision. In the *Anthropoidea* this expansion has been met by the eversion of the medial laminae while in the larger members of the *Lemuroidea* it has been accommodated by the crinkling up of these laminae into a series of small convolutions. We may infer, from a consideration of these opposite tendencies in the elaboration of the lateral geniculate body in these two suborders, that in the common ancestral form from which they have presumably been derived, the laminae

of the lateral geniculate body must have been of simple disposition and uncomplicated by a folding in either direction. Taking all the available data into account, there is reason to presume that the lateral geniculate body of this hypothetical ancestor would hardly have been much more elaborate than it is in the larger tree-shrews. In other words, the *Anthropoidea* and *Lemuroidea* must have diverged in the process of their evolution from a very primitive ancestral type.

The significance of the Lamination of the Dorsal Nucleus of the Lateral Geniculate Body.—In the elaborate types of lateral geniculate body, lamination of its constituent cells is a very conspicuous feature. In the higher Primates, *e.g.*, man and most monkeys, a six-layered structure is produced, consisting of two large-celled superficial laminae and four deeper layers of medium-sized cells. These layers of the fully developed lateral geniculate body may conveniently be designated by the figures 1*a*, 1*b*, 2*a*, 2*b*, 3*a* and 3*b*. There is some reason to believe that this six-layered type is derived from a three-layered type. Thus in sub-primate forms such as carnivora[23] there is a superficial large-celled lamina and two deeper laminae of medium cells, and in the primitive Primate *Tarsius* the trilaminar type is also to be found.[8] The significance of this primary lamination is obscure, but it has been suggested that the lamination in higher Primates is related to the hemi-decussation of the optic tract. Minkowski[22] has described and figured the changes in the lateral geniculate body of a monkey which occur after enucleation of one eye. He found chromatolytic degeneration in one set of alternate laminae of the lateral geniculate body of one side, and in the other set of alternate laminae of the opposite side. From this he inferred that crossed and uncrossed fibres terminate alternately in successive cell laminae. This conclusion has not been generally accepted. Brouwer, in his enquiry into the question of localisation in the lateral geniculate body, depended on the Marchi method. He found that in the monkey the "monocular" area is limited to the basal part (roughly corresponding, by the way, to the superficial large-celled lamina which I have here called lamina 1*a*). As regards the retinal fibres related to the binocular field of vision, he could only go so far as to conclude that the crossed and uncrossed fibres are closely intermixed in the lateral geniculate body and he was unable therefore to confirm or disprove Minkowski's conclusion.

I have recently been fortunate enough to obtain material bearing on this most important question. The first specimen is the brain of a monkey (*Macacus nemestrinus*) whose left eye had been destroyed as the result of an accident seven months before death. For this specimen I am indebted to Dr. Zuckerman and the Zoological Society of London. An examination showed that the



A. PLATE 1. B.

Sections through the left (A) and the right (B) lateral geniculate bodies of *Macacus nemestrinus* in which the left eye had been destroyed 7 months before death. In both cases the lateral aspect is towards the right.

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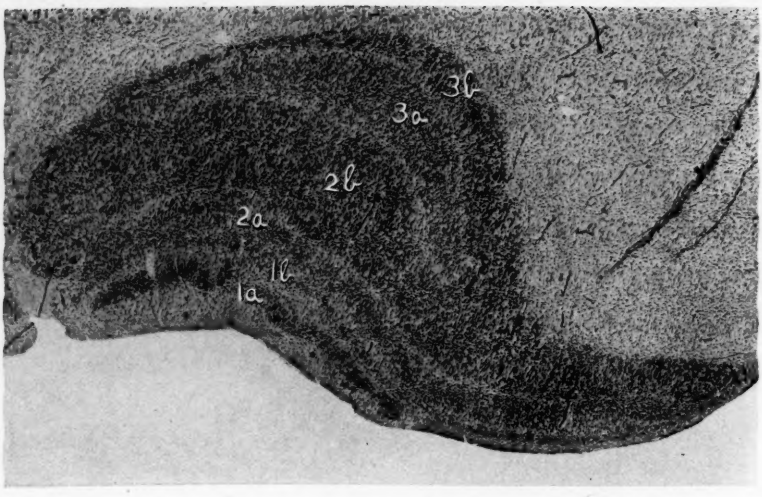

PLATE 2A.

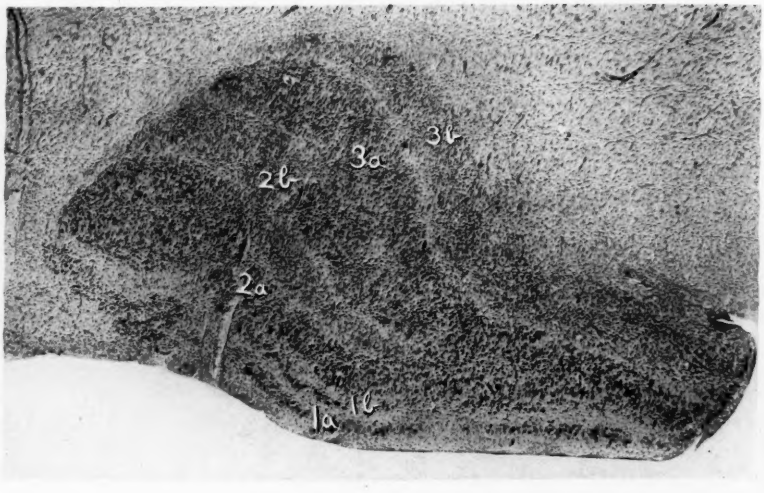

PLATE 2B.

Sections through the left (A) and the right (B) lateral geniculate bodies of a woman whose left eye had been removed for glaucoma 2 years before death. In both cases the lateral aspect is towards the right.

left eye had undergone complete atrophy and the corresponding nerve had also degenerated. The geniculate bodies were cut transversely and numerous sections through the central part of the body stained with Borell's methylene blue. Photographs of typical sections are shown in Plate 1. The cells of lamina 1*a* on the right side had undergone complete chromatolysis with the exception of a few scattered cells seen in some sections which were pale and atrophic. On the left side this layer appears normal. Lamina 1*b* on the right side consists of a regular layer of large and deeply

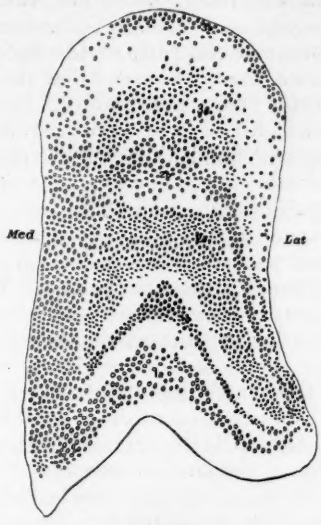

FIG. 7.

Diagram of a transverse section of the lateral geniculate body of *Macacus nemestrinus*, constructed from a study of serial sections through the middle of the body. The cell laminae receiving crossed fibres of the optic tract are represented by circles, those receiving uncrossed fibres by black dots.

staining cells of normal appearance, while on the left side they are shrunken and atrophic except for a few odd cells here and there. Lamina 2*a* on the right side is a thick lamina of closely packed normal medium-sized cells, and on the left this layer is completely atrophied. Lamina 2*b* contains no normal cells at all on the right side, and on the left it contains numerous cells of normal appearance, somewhat diffusely arranged. Lamina 3*a* on the right side appears normal and on the left has disappeared except for a few isolated cells seen here and there in odd sections. Lamina 3*b* has undergone complete atrophy on the right, and on the left side it is still to be distinguished. In Fig. 7 a composite diagram is shown in

which the distribution of normal cells of the right and left lateral geniculate bodies has been plotted out from the study of serial sections through the middle of the body. It is clear that there is a very definite relation between the lamination and the termination of crossed and uncrossed fibres of the optic tract, even though a very slight intermingling may occur in laminae 1*b* and 3*a*. Crossed fibres end in laminae 1*a*, 2*b* and 3*b*, and uncrossed fibres in laminae 1*b*, 2*a* and 3*a*. It will be observed that in the central part of the lateral geniculate body laminae 2*b* and 3*b* fuse to form a thick column of cells on the medial side, and thus it seems that a relatively greater proportion of crossed fibres terminate in the more medial than in the more lateral parts of the body. Further, if the body is considered as a whole, it is seen that the more peripherally situated laminae receive only crossed fibres.

The second case which I wish to report here is that of a woman, aged fifty-four years, who had had her left eye removed for glaucoma two years before death. At the autopsy nothing abnormal was found on macroscopical examination of the brain except for atrophy of the left optic nerve. The lateral geniculate bodies were excised and paraffin sections were made in a coronal plane, the sections being stained with Borell's methylene blue. The normal human lateral geniculate body is very conspicuously laminated and, as in monkeys, six laminae can be recognised of which the two superficial are formed of large deeply staining pyriform cells from the deep aspect of which long branching processes arise, while the four deeper laminae are composed of medium-sized cells, triangular and fusiform in shape and fairly closely packed together. In this particular case cellular atrophy of the laminae was found as in the monkey. Microphotographs of the geniculate bodies of the two sides are shown in Plate 2. On the left side, lamina 1*a* is a relatively thick layer of large deeply staining cells of the normal type, the layer being interrupted only here and there by the passage of blood vessels. The fine branching dendritic processes of these cells show up well with the stain used and form a rich matrix of intertwining processes which permeate the whole layer. On the right side there are no cells of normal size left. They have all shrunken to the size of the cells in the deeper layers or smaller, and a high-power examination shows that they have undergone chromatolytic changes and the dendrites are very much less conspicuous. On the other hand lamina 1*b* (which, in the middle of the lateral geniculate body is shorter in transverse extent than lamina 1*a*) contains normal large cells on the right side, while, on the left all the cells are much reduced in size. Of the medium-sized cell laminae, on the left side laminae 2*b* and 3*b* are normal, the cells staining well and their dendrites showing up very distinctly, while laminae 2*a* and 3*a* consist of cells which have undergone complete chromatolysis and

are very much shrunken. On the right side laminae *2a* and *3a* are normal in every respect, while laminae *2b* and *3b* have atrophied. A close search through the atrophied layers on both sides occasionally reveals what appears to be a normal cell, but these are extremely rare. Thus, on the left side, in lamina *3a* there were found in one section three normal cells, in another section five, and in another two. Similarly in lamina *2b* on the right side there could be detected one, two or three cells of normal appearance in odd sections. Such occasional normal cells among many thousands of atrophied cells obviously can be of little significance. The changes which occur in the lateral geniculate body of the human brain after unilateral optic atrophy are exactly similar to those found in the lateral geniculate body of the monkey, and are even more precisely and definitely marked.* Crossed fibres of the optic tract evidently terminate in laminae *1a*, *2b* and *3b*, while uncrossed fibres end in laminae *1b*, *2a* and *3a*. The functional relation of the laminae of these two groups is further indicated by the fact that, as can be followed by a study of serial sections, the individual laminae are in some part of their extent structurally continuous with each other. This is shown in the microphotographs in Plate 2. The sections shown here have not been made in precisely corresponding planes and they show clearly that in some planes (as shown here on the left side) laminae *3b*, *2b* and *1a* are in direct continuity with each other at their lateral extremities, while in other planes (as shown here on the right side) laminae *3a*, *2a* and *1b* are continuous. Similar relations of alternating laminae are also evident enough in the lateral geniculate body of the monkey. Thus in each geniculate body there are two sets of three laminae, the individual laminae of each separate set being structurally continuous with each other, and each set interlocking with the other. The two sets of laminae, moreover, are related one to the termination of crossed fibres of the optic tract and the other to the termination of uncrossed fibres.

REFERENCES

1. **Bellonci, J.**—Ueber die centrale Endigung des Nervus opticus bei den Vertebraten. *Zeits. f. wiss. Zool.*, Bd. XLVII, p. 1, 1888.
2. **Biemond, A.**—Experimentell-anatomische Untersuchungen über die cortifugalen optischen Verbindungen bei Kaninchen und Affen. *Zeits. f. d. gesamte Neur. u. Psych.*, Bd. CXXIX, Heft. 1 and 2, p. 65, 1930.
3. **Bouman, K. H.**—Experimenteele Onderzoekingen over het Cerebrale Optische Stelsel. *Academisch Proefschrift.* Univ. v. Amsterdam, 1905.

* The visual cortex of the calcarine region of both sides in this case of unilateral optic atrophy was sectioned and examined. No perceptible difference in the development of the two layers of granule cells in the lamina granularis interna could be detected. Thus no evidence is provided in support of the suggestion made by Barany that one layer is related to homolateral visual impulses and the other layer to heterolateral visual impulses.

4. **Brouwer, B.**—Experimentell-anatomische Untersuchungen über die Projektion der Retina auf die primären Opticus-zentren. *Schweiz. Arch. f. Neur. u. Psych.*, Bd. IX, p. 118, 1923.
5. **Cairney, J.**—A general survey of the forebrain of *Sphenodon punctatum*. *Jl. Comp. Neur.*, Vol. XLII, p. 255, 1926.
6. **Cajal, S. R. y.**—Histologie du Système Nerveux. Paris, 1911.
7. **Clark, W. E. Le Gros.**—The Thalamus of *Tupaia minor*. *Jl. Anat.*, Vol. LXIII, p. 117, 1929.
8. ——— The Thalamus of *Tarsius*. *Jl. Anat.*, Vol. LXIV, p. 371, 1930.
9. ——— Proceedings of Anatomical Society. *Jl. Anat.*, Vol. LXVI, p. 138, 1931.
10. ——— The Brain of *Microcebus murinus*. Proceedings of Zoological Society, London, Part II, p. 30, 1931.
11. **Durward, A.**—The cell masses in the forebrain of *Sphenodon punctatum*. *Jl. Anat.*, Vol. LXV, p. 8, 1930.
12. **Edinger, L.**—Untersuchungen über die vergleichende Anatomie des Gehirns. 1V. Frankurt, 1899.
13. **Gaupp, E.**—Anatomie des Frosches. Abt. 2, Braunschweig.
14. **Gurdjian, E. S.**—The diencephalon of the albino rat. *Jl. Comp. Neur.*, Vol. XLIII, No. 1, p. 1, 1927.
15. **Herrick, C. J.**—The internal structure of the midbrain and thalamus of *Necturus*. *Jl. Comp. Neur.*, Vol. XXVIII, No. 2, p. 215, 1917.
16. **Huber, G. C.**, and **Crossby, E. C.**—On thalamic and tectal nuclei and fibre paths in the brain of the American alligator. *Jl. Comp. Anat.*, Vol. XL, No. 1, p. 97, 1926.
17. ——— Somatic and visceral connections of the diencephalon. *Arch. of Neur. and Psych.*. Vol. XXII, p. 187, 1929.
18. **Kappers, C. U. Ariens.**—Die vergleichende Anatomie des Nervensystems der Wirbelthiere und des Menschen. Haarlem, 1921.
19. **Kornyey, S.**—Zur vergleichenden Morphologie des lateralen Kniehöckers der Säugethiere. *Arbeit. aus dem Neur. Inst. an der Wien. Univ.*, Bd. XXX, 1927.
20. **de Lange, S. J.**—Das Zwischenhirn und das Mittelhirn der Reptilien. *Folia Neurobiologica*, Bd. VII, p. 67, 1913.
21. **Loepp, W. H.**—Ueber die zentralen Opticusendigungen beim Kaninchen. *Anat. Anz.*, Bd. XL, 1912.
22. **Minkowski, M.**—Ueber den Verlauf, die Endigung und die zentrale Reprasentation von gekreuzten und ungekreuzten Sehnervenfasern bei einigen Säugethieren und beim Menschen. *Schweiz. Arch. f. Neur. u. Psych.*, Vol. VII, p. 201, 1919.
23. **Rioch, D. M.**—Studies on the diencephalon of carnivora. *Jl. Comp. Neur.*, Vol. XLIX, p. 1, 1929.
24. **Shanklin, W. M.**—The central nervous system of *Chamaeleon vulgaris*. *Acta Zoologica.*, Bd. XI, p. 425, 1930.
25. **Tretjakoff, D.**—Das Nervensystem von *Ammocoetes*. II. Gehirn. *Arch. f. mikr. Anat.*, Bd. LXXIV, 1909.
26. **Tsai, C.**—The optic tracts and centres of the opossum. *Jl. Comp. Neur.*, Vol. XXXIX, No. 2, p. 173, 1925.
27. **Wlassak, R.**—Die optischen Leitungsbahnen des Frosches. *Arch. f. Anat. u. Phys.*, 1893.
28. **Woollard, H. H.**—Notes on the retina and lateral geniculate body of *Tupaia*, etc. *Brain*, Vol. XLIX, Part I, 1926.

TUBERCULIN IN OPHTHALMOLOGY

BY

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LONDON

IT has fallen to the lot of all of us at times to have to treat obstinate chronic inflammatory conditions of the eye where no definite cause has been discoverable for the condition. I am referring to diseases such as keratitis profunda, irido-cyclitis, choroido-retinitis, and persistent fine vitreous opacities without any obvious fundus lesion.

The ordinary routine examinations are performed. A Wassermann reaction is done, the teeth are examined radiologically and clinically, the tonsils, nasopharynx and sinuses are overhauled and search is made for evidences of chronic prostatitis and vesiculitis, all with negative results; or some positive finding is made, *e.g.*, a few infected teeth are found, and the patient shows no improvement after their extraction. Possibly the examination is carried still further, cultures are made from the stools and urine, and a barium meal may even be given to find out if there be intestinal stasis, and yet no definite cause can be discovered for the patient's condition. In such a state of affairs it has been my custom, and I am sure that of many others, to "try tuberculin," and it is surprising how often the trial proves completely successful. The object of this paper is

1. To try and give some experimental explanation for the success of this reagent, in cases which are obviously not tuberculous.
2. To give some clinical experiences.

To start with the theoretical and experimental side:—When vaccines were first introduced, there was a general idea that their effect was essentially specific and that the employment of an autogenous vaccine was all important, but it has now become apparent that there is such a thing as non-specific immunity, and farther that the non-specific response may be more potent than the specific one. To show the sort of thing that happens with tuberculin B.E., I should like to quote one of Sir Almroth Wright's numerous experiments. He took a series of capillary tubes and drew into one 10 cubic millimetres of a broth suspension of staphylococcus, then 10 separate cubic millimetres of blood. The first cubic millimetres would obviously get the heaviest dose of staphylococci and the following ones progressively less, so that he had in his tube a series of 10 separate cubic millimetres of blood implanted with a progressively diminishing number of staphylococci. This tube was used as a control and contained untreated blood; in the second the blood was inoculated with a small dose of tuberculin

and in the third with a larger dose. Wright has already shown that *in vitro* the immunising response to a vaccine is instantaneous, and we therefore have in these three tubes, something comparable to thirty patients, of whom the first 10 have a diminishingly severe staphylococcal infection, the second 10 a similar series of infections, but also a small dose of tuberculin and the third 10 a larger dose. What happened? By a technique which need not be detailed, Wright was able to find out the number of organisms which survived in each separate cubic millimetre of blood and the result was broadly as follows. In the case of the heavily implanted bloods the effect of the large dose of vaccine was to allow them to grow more than twice as many colonies as in the control blood, whereas the small dose of vaccine reduced the number to nearly half what grew in the controls. In the lightly implanted bloods, however, the large dose of vaccine enhances the bactericidal power more than does the small dose. From this and similar experiments, Wright deduces that there is a certain dose of antigen, which produces the optimum immunity response. If the blood is already heavily infected it requires only a small addition of antigen to bring the concentration up to the optimum, but if the infection is slight then more of the artificial antigen is required. The importance of determining the correct dose is therefore obvious, and Wright has devised "the vaccine response test" (*Lancet*, March 10, 1923) to find out what is the optimum amount of vaccine to give. The result of this and similar experiments is such as to make Wright say in a recent publication in the *Lancet* (August 15, 1931), "That when I operate on my blood with a tubercle vaccine (B.E.) I get better—that is, more emphatic, and for the same dose employed, more consistent—immunising response than when I operate with staphylococcus vaccine." For this reason he recommends that when the nature of the infecting agent cannot be determined, "a passionate conviction that immunity is specific should not be allowed to hold us back from inoculating minimal doses of tuberculin B.E. or in the cases associated with rheumatoid changes, a vaccine of intestinal streptococci."

With regard to the variety of tuberculin employed, the nearer we get to nature, the better, so up to date I have always used the bacillary emulsion.

The theoretical rationale for this is as follows:—For the most part, antigens are proteins. It is not known yet to what they owe their antigenic properties, though there is evidence that the benzene rings play an important part. Thus gelatine which contains no tyrosine or tryptophane is devoid of antigenic properties while other proteins possessing a full complement of aromatic radicles but deficient in some of the amino-acids commonly present, possess definite antigenic properties.

Another point about antigens is that they must be non-diffusible colloids. The reason for this is that if they could enter the cells, they would be destroyed therein, but as the cell cannot deal with them in this way it must elaborate some extracellular antibody to react with the foreign protein as a prelude to its destruction. Evidence of this is afforded by the observation that the cleavage products of an antigen even when injected all together have no antigenic capacity, but if reunited into colloidal molecules this capacity is restored. In therapeutics, we are of course concerned with the production of antibodies, and we have already seen that the amount of these which is produced does not vary directly with the amount of antigen injected. In fact small doses often produce more than large doses, and this is a point which is of great importance in determining the dosage of tuberculin.

In this connection one has also to consider the question of allergy. One cannot help feeling that some of the chronic eye diseases are of this nature, though I admit it has not been proved except in the case of interstitial keratitis and phlyctenular disease, and one knows that the whole secret of desensitisation is to give very small doses. My practice, therefore, is to start with something like 1/500,000 mg. of B.E. and work the dose up very slowly. Rich and McCordock have some interesting things to say on this subject and draw a distinction between the immunity and allergic reactions. The immunity reaction leads to death of the bacilli while the allergic reaction is the response of the tissues to the liberated protein. By administering repeated, increasing doses of tuberculin to the allergic human subject, a desensitisation to tuberculin may be established to such a degree that the individual becomes able to tolerate relatively enormous doses, without inflammation, necrosis, or constitutional symptoms. Tissue necrosis in tuberculosis is almost entirely the result of allergic hypersensitiveness to tuberculo-protein and if resistance is independent of allergy, the reduction of the necroticising effect of hypersensitiveness to the bacillary proteins could easily be understood to be beneficial. The formation of tubercles would not appear to be an allergic reaction, since it can be brought about by a lipoid extracted from the bacillus which lipoid itself does not produce any allergic changes. For the production of allergy it is necessary to use whole bacilli, and it appears that it has not yet been possible to extract from them the true sensitising antigen. By analogy, therefore, desensitisation would appear to be best produced by the same reagent, *i.e.*, whole bacilli and not extracts, and this seems to furnish an additional indication for the use of tuberculin B.E. in preference to T.R., etc. Another way of looking at allergy is to regard it as a change in the body whereby the relatively bland products of the breakdown of tubercle bacilli are converted into

powerful irritants and poisons without any apparent gain to the organism in the way of immunity. In fact, allergic reactions have the effect of spreading rather than fixing the bacilli. Thus Krause and Willis produced allergic reactions with tuberculin, in the skin of immunised animals, and into these inflamed areas injected virulent bacilli. These animals developed more widely spread tuberculosis than did controls where the injection was made into normal areas of skin. Healing of tuberculous foci is also thought to be interfered with by allergy.

This separation of immunity and allergy seems important and would explain very nicely some of the mild cases of doubtful tuberculous iritis. An old focus of tuberculosis, for example, lights up as a result of extreme exhaustion; the tubercle bacilli are disintegrated as the patient has acquired immunity and in their disintegration they set free tuberculo-protein. Unfortunately the patient is also allergic and therefore develops the so-called tuberculids such as asthma, iritis, or arthritis.

The bad effect of allergy is shown very strikingly by some tissue culture experiments performed by Rich and Lewis (*Proc. Soc. Exp. Biol. and Med.*, Vol. XXV, p. 596, 1928).

They placed thoroughly washed, fixed tissue and blood cells of allergic and of normal guinea pigs in the plasma of normal and of allergic animals, and the same amount of tuberculin was added to all the cultures. The cells from allergic animals were regularly and promptly killed when exposed to tuberculin, regardless of the plasma in which they were placed, while the cells from normal animals, regardless of the plasma in which they were placed, remained alive and multiplied when exposed to the same concentrations of tuberculin which rapidly killed the allergic cells.

Turning to the clinical side, before discussing purely ophthalmic cases, I should like to allude to some experiences of Houghton in a tuberculosis sanatorium. His results are not ready yet for publication, but he was kind enough to write to me a very interesting letter which seems to have a strong bearing on the non-specific effect of tuberculin. He says:—"I have been for some time convinced that infection with tuberculosis (by which I mean active disease) confers a considerable degree of resistance to infection by other organisms, particularly streptococcal and pneumococcal and to some extent staphylococcal infection. This is, however, an extremely difficult contention to prove. The idea of any non-specific immunity suggested itself to me as the result of my own clinical experience of tuberculosis during the past four years, during which time I have seen no acute infections attributable to the common organisms except in cases in which the diagnosis of tuberculosis has not been confirmed. I have suggested this to others whose experience of tuberculosis is far greater than mine and they have, on consideration,

agreed. So far this is a purely clinical opinion. The hospital has 350 beds devoted entirely to pulmonary tuberculous cases of all ages, and on examining the statistics for the past ten years, I find that absence of non-tuberculous disease among the patients is striking. I am at present engaged in going into the case papers in detail, but am not yet in a position to give any actual figures. In any case these figures would be of little statistical value without a set of figures for comparison, and that, of course, is one's great difficulty. I have, in the past, attempted animal experiments, but they are intended rather as preliminary efforts. Encouraged however, by Sir Almroth Wright's work, I am now carrying on with these on a larger scale. I think it is a common experience to find that in cases of tuberculous empyema which have had a rib resected for drainage purposes, and which do eventually become secondarily infected, the activity of the T.B. process subsides, and a chronic discharging sinus results. I have treated one or two such cases as these with tuberculin, on the principle that the secondary infection has overcome the T.B. infection. The results have been very encouraging, the pus becoming scantier and the sinus tending to close. I am also attempting to raise the resistance to T.B. infection by the converse process, but although I have a considerable number of cases under observation, I am not yet in a position to give an opinion. I have not yet published anything on this question as I feel that at present my ideas are too indefinite. I am hoping, however, within the next few months to have some more concrete facts to produce."

These statements seem to bear out Wright's experimental observations, and afford some justification for the ophthalmic surgeon resorting to tuberculin in cases of obscure aetiology.

The following cases may be of interest from the clinical standpoint:—

The first was a woman, E.H., aged 37 years, whom I took into hospital for disciform keratitis in the left eye. All investigations were negative, except that dental sepsis was present, and five infected teeth were removed. On leaving the wards, she had fine keratic precipitates, a partially healed focus of choroido-retinitis, and a considerable amount of vitreous haze. She had her first dose of tuberculin on January 4, 1930, and when I saw her on January 10, she asserted that she felt very much better, though the haze was still very thick. A fortnight later it was beginning to clear, and by the end of March she could see 6/12. In July, *i.e.*, six months after starting tuberculin, vision was 6/5 partly, and the haze was almost gone, except for a ring-like opacity in the vitreous, which resembled the condition seen in a case of Sir William Lister's, and described as a hole in the hyaloid. The tuberculin was therefore stopped; she was by now up to 1/50 mg., but she was instructed to return for a

further course of injections in two months. The patient waited for nearly four months before coming back. By this time, vision had gone down to 6/12 partly, and the vitreous haze had returned. Tuberculin administration was resumed, and within five weeks the haze had almost disappeared, with a corresponding improvement of vision up to 6/5 partly. The last occasion on which I saw her was in March of this year, when vision was 6/6 partly. An obvious criticism of this case is that it was probably one of tuberculous keratitis and choroiditis, but all I can say is that there was no clinical evidence of tuberculosis, and that the precipitates were at no time of the mutton-fat type. This of course does not exclude tuberculosis as an aetiological factor, but whatever one may think about the choroid, one would not expect a tuberculous keratitis to clear up in this way, and leave no sequelae of vascularisation, etc.

The beneficial effects of tuberculin in scleritis and episcleritis are too well known to need much description, but the following case may be of interest, if only by way of supporting Wright's theory about the optimum dose of antigen. M.C., a woman, 45 years of age, consulted me at home in September, 1924, with a bad attack of scleritis in the right eye, the left one having been enucleated some 30 years before. I sent her to the Central London Ophthalmic Hospital with a note to the house surgeon, advising an injection of 1/200,000 mg. of tuberculin. Two days later, when I saw her at hospital, I was surprised to find that the eye was white, and free of all evidences of active inflammation. It was rather a dramatic change, and I asked the house surgeon what dose she had given of tuberculin, and received the reply, 1/20,000 mg. I should never have dared to start with a dose like that myself, but the result was satisfactory. This patient has been under observation at intervals since this time, and has had a few relapses, each of which has been cured by tuberculin. I saw her last three weeks ago with a perfectly white eye for the last seven months, during the whole of which time she had been on tuberculin B.E.

A case of another type is H.C., who suffered from attacks of recurrent iritis for something like 30 or 40 years. She had every sort of treatment one could think of, and was the type of recurrent iritis which is associated with rheumatoid changes. It was not until December, 1929, that I thought of trying tuberculin, and then largely because there seemed to be some episcleritis associated with her attacks of iritis. As long as she continued her injections, she remained free of attacks, but if she stopped them for only a short period, she seemed to get a relapse. Last November she had hemiplegia, and died shortly after from heart failure.

Another case in which tuberculin had a remarkable remedial effect was that of Miss W., who had numerous small staining areas on her cornea, with much photophobia and lacrymation. The usual local

treatment produced no effect, nor did the removal of some infected teeth, in fact the condition became worse, and after some days of in-patient treatment, I noted the development of a deep infiltrate in the cornea of a disciform type. Remembering the first case, I thought it would be worth while to try tuberculin again, and the result was that within a few days the deep opacity had disappeared, and the superficial areas were beginning to heal.

Another case of chronic iritis may have been definitely tuberculous. She was a woman aged 49 years, who had had recurrent iritis since the age of 17, and was under the care of Mr. Paton. When he saw her in July of last year, both irides were almost completely bound down, and there was a history of a past attack of iritis with raised tension and pain. The patient had to return to India in a few months, so a double iridectomy was indicated. No septic focus was found, so she was given milk injections and intensive salicylate treatment with little effect. I saw her several times during Mr. Paton's absence on holiday, and ordered tuberculin. The first dose of 1/100,000 mg. produced no effect, but the second of 1/75,000 produced a little shivering, and some pain in the eye. The dose was therefore reduced, and then worked up more slowly, with a result that in a month the condition of the eye was markedly improved, and iridectomy was performed two weeks later without any complications.

I am afraid that these case reports are thoroughly empirical and unscientific, but it is difficult to know quite where to begin if the subject is to be worked out satisfactorily.

It seems to me that we have two questions to decide.

1. Are we missing a certain number of cases of tuberculosis by falsely attributing the lesion in the eye to some other cause, and not finding the true diagnosis until tuberculin is administered?

2. Has tuberculin a definitely non-specific immunising effect against organisms other than the tubercle bacillus and thus brings about cure?

With regard to the first question, how are we to exclude a tuberculous aetiology? We know that tuberculous affections of the cornea and uveal tract do not by any means always give rise to pathognomonic changes, and, we have the assurance from pathologists that something like 90 per cent. of human beings harbour a tuberculous infection somewhere in their bodies.

This is emphasized particularly by Urbanek. In an examination of 500 cases of tuberculous uveitis, he pointed out that there was no typical clinical or pathological picture that indicated a tuberculous involvement of the eye, and this even with the slit-lamp examination. He goes so far as to say that acute tuberculous conditions may even present the well-known appearance of gonococcal iritis, with its gelatinous aqueous.

With regard to the second question, we have Sir Almroth Wright's work, which seems to show that tuberculin B.E. is a very good antigen for staphylococcal infections. I feel, therefore, that the therapeutic, non-specific effect of tuberculin is a matter that ought to be subjected to further scientific investigation.

REFERENCES

1. Wright, Sir Almroth.—*Lancet*, August 1, 8 and 15, 1931.
2. ——— *Lancet*, March 10, 1923.
3. Rich and McCordock.—*Bull. Johns Hopkins Hosp.*, No. 5, Vol. XLIV, May, 1929.
4. Rich and Lewis.—*Proc. Soc. Exp. Biol. and Med.*, Vol. XXV, p. 596, 1928.

HARDNESS OF THE EYE: AN HISTORICAL NOTE

BY

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LONDON

WHEN Brisseau[1] established, in 1709, that cataract was a change in the lens itself, and not an organised opacity in front of it, he also advanced the view that glaucoma, which up to then was regarded as dessication of the lens, was not a lesion of the lens at all, but a change in the vitreous. The clinical conception of glaucoma then prevailing was no less confused, and 150 years had to pass before the essential features of the disease were clearly recognised. The general recognition of such a thing as hardness of the eye had still to come, and its recognition as the characteristic sign of glaucoma was a very late achievement.

William Mackenzie[2] is generally credited with establishing hardness as a feature of glaucoma. In his classical textbook (1st edition, 1830) he repeatedly stresses this association. He contrasts the blindness of glaucoma with that of cataract:

> The eyeball in glaucomatous amaurosis always feels firmer than natural; while in cataract, it presents its usual degree of resistance to the pressure of the finger. (1st edition, p. 572.)

On the succeeding page (p. 573), he states, in discussing the cataractous eye:

> A stony hardness of the eye denotes glaucoma.

He also recognised acute glaucoma, though this term is not employed in the first edition, making its first appearance in the

second (1835). He gives a brief but vivid description of an acute attack, and adds:

> After some time the inflammatory symptoms subside . . . and instead of the preternatural hardness which it formerly presented (the eye) becomes boggy. (p. 707.)

Nowhere in the literature before Mackenzie is there such a clear recognition of hypertension as an essential characteristic of glaucoma, both acute and chronic. But the conception as a whole was by no means original with Mackenzie. It was, so to speak, very much in the air in the early decades of the 19th century. Fabini,[3] in a Latin treatise published in Pesth in 1831, also speaks of stony hardness in glaucoma.

> *Bulbi normali elasticitas in duritiem fere lapideam mutatur acceditque vasorum oculi varicositas.*

Hardness as a feature of both developing and established glaucoma (acute glaucoma going on to absolute glaucoma) is clearly brought out in "Traité théorique et pratique des Maladies des Yeux," par M. le Dr. Weller, Paris, 1828, translated from the 3rd German edition, with additional notes by L. Jallat.[4] The description of hardness is not a French interpolation. It is original in the 3rd German edition of Weller's "Krankheiten des menschlichen Auges"[5] (1826) though no such reference is found in the 1st German edition (1819), nor in its English version: "Manual of the Diseases of the Human Eye . . . G. C. Monteith" (1821).

But hypertension in glaucoma was known even before then. There is an excellent clinical description of glaucoma in its acute phase in A. P. Demour's Treatise[6] of 1818. Hardness is clearly recognised: *le globe devient dur au toucher.*

The earliest reference to hardness of the eye is said to date from 1745, occurring in J. Z. Platner, "Institutiones chirurgiae rationalis." He distinguishes two types of glaucoma—one due to swelling of the lens and capsule, in which group the eye becomes hard, and the other due to swelling of the vitreous, in which case the eye becomes soft.

> *Proximum his vitium in lente crystallina est, si ea cum suo velamento multum et ita intermescit, ut reliquae oculorum partes ab ea premantur. Hoc his indiciis cognoscitur: oculis durus, digito renitens. . . .*

That the honour of first recognising hardness of the eye belongs to Platner is vouched for by no lesser authorities than H. Schmidt-Rimpler, J. Hirschberg and A. Terson. This, however, is not the case. The credit must be given to Richard Banister, who recognised hardness of the eye practically a century and a quarter earlier.

Richard Banister has received scanty justice at the hands of

medical historians. Reputed, for mistaken reasons, to be the author of "A Worthy Treatise of the Eyes," published in 1622, it has been shown that he only edited it; perhaps, as a consequence, his own contribution, Banister's "Breviary of the Eyes," running to 112 pages, and making part of the composite volume in which the aforementioned "Worthy treatise" appears, has received but little attention. Yet it is obviously the work of an honest man and a careful observer. The whole composite volume, "A treatise of one hundred and thirteene diseases of the Eyes and Eye-liddes," has its pages unnumbered. In Banister's Breviary, a discussion on gutta serena appears after the verses on The fit time for couchi[ng] of Cataracts. Banister stresses the seriousness and almost complete hopelessness of gutta serena (blindness associated with a transparent pupil, as opposed to gutta obscura, in which blindness is associated with an obscured pupil). He had two successes, but many failures, in the treatment of gutta serena, and he goes on to say:

> When it pleaseth God to inable my skill, that I understand a more perfect Cure for this dangerous disease, I will publish the meanes that are most effectual and approved, whereby the Practitioner and the Patient may be the lesse mistaken in their expectation, but according to my observation, I will shew my opinion, where most hope of Cure is: if the humour settled in the hollow Nerves, be growne to any solid, or hard substance, it is not possible to be cured; which may be iudged of, foure wayes. First, if it be of long continuance. Secondly, if they see no light at all of the sun, fire or candle. Thirdly, if one feele the Eye by rubbing upon the Eie-lids, that the Eye be growne more solid and hard, than naturally it should be. Fourthly, if one perceive no dilatation of the *Pupilla*, then there is no hope of Cure. Contrariwise, if the sight hath beene lost but a small time, viz., a moneth or two, if the Eye be perceived soft and pliable, if there be any dilatio in *Pupilla*, though it can scarcely be perceived, yet there is some hope of Cure.

The Breviary published in 1622 is dated from Stamford, "the last of Iune," 1621. In the clear recognition of hardness of the eye, not only as a physical, but also as a prognostic sign of the utmost importance, Banister is thus 124 years before Platner. His observations, however, fell on sterile soil; it was well over 200 years before his teaching became part of ophthalmic practice.

A peculiar passage appears in Peter Kennedy's *Ophthalmographia* or A Treatise of the Eye, London, 1713: "When the Cataract is come to the full Ripeness or Maturity. . . . the sights of Objects is now gone, but shadows of Light and Darkness they are still sensible of; if otherwise, there is but little hope of succeeding [in

operation]; the common ways of tryal is to shut the Eye, and rubbing it a little with the Finger, immediately open it to Light, and observing the Pupil to contract it self is a good sign.

Although this Method is frequently used, yet I see no reason for rubbing; another way I think as good, such as putting the Hand before the Eye, and suddenly take it away, or putting the patient in a darkish part of the Room, and bringing him nearer to the Window or Light, and the pupil contracting as I've said, is a good sign. . . . If the Pupil contracts but slowly, it is a token of its being old and of very long continuance. . . . If the Uvea [=Iris] have lost its Contraction and Dilatation, it's a very bad sign" (pp. 84-85).

This passage (and much more of the book) is obviously an elaboration of Banister. Banister's four rules (duration, perception of light, rubbing the eyelid and pupil reaction) are here given in a modified and, on the whole, better manner, though his observation on "rubbing upon the Eie-lids" seems to have been misunderstood. It is noteworthy that Kennedy speaks of it as a common practice; yet it is not found mentioned anywhere in English literature before Mackenzie. Banister's observation on hardness of the eye seems to have become debased into "rubbing the eye" before testing the pupil reaction to light, and subsequently to have become discarded altogether.

REFERENCES

1. **Brisseau, M.**—Traité de la cataracte et du glaucome. Paris, 1709.
2. **Mackenzie, W.**—A practical treatise on the diseases of the eye. London, 1st edition, 1830; 2nd edition, 1835.
3. **Fabini, J. T.**—Doctrina de morbis oculorum, p. 231. Pesth, 1831.
4. Traité théorique et pratique des maladies des yeux, par M. le Dr. Weller, traduit de l'Allemand sur la 3e. edition par F. J. Riester; augmenté de notes par L. Jallat. Tome 1, p. 349. Paris, 1828.
5. **Weller, C. H.**—Die Krankheiten des menschlichen Auges. 3te Auflage, p. 295. Berlin, 1826.
6. **Demours, A. P.**—Traité des Maladies des Yeux. Tome 1, p. 470. Paris, 1818.
7. **Platner, I. Z.**—Institutiones Chirurgiae rationalis tum medicae tum manualis, p. 889. Lipsiae, 1745.
8. **Schmidt-Rimpler, H.**—In *Graefe-Saemisch*. 1te Auflage. Band 5, Theil III, p. 74. Leipzig, 1877. 2te Auflage. Band 6, Abth. 1, p. 140. Leipzig, 1908.
9. **Hirschberg, J.**—In *Graefe-Saemisch*. 2te Auflage. Band 14, Abth. 11, p. 307. Leipzig, 1911.
10. **Terson, A.**—Les premiers observateurs de la dureté de l'oeil dans le glaucome. *Arch. d'Ophtal.*, Tome XXVII, p. 625, 1907.
11. **Banister, R.**—Breviary of the Eyes: In A treatise of one hundred and thirteen diseases of the Eyes and Eye-Liddes. The second time published. . . . London, 1622.

A FAMILY OF GROENOUW'S DYSTROPHY

BY

E. V. SRINIVASAN

MADRAS

WHAT appeared as nodular dystrophy of Groenouw with focal illumination and corneal loupe turned out to be lattice-shaped dystrophy in the three oldest ones of the following family under the slit-lamp microscope.

Regular ribbon-shaped bands were seen traversing irregularly throughout the middle two-thirds of the cornea, the branching becoming less dispersed towards the periphery. The cornea between the bands is quite cloudy under the microscope. The posterior cornea showed irregular amorphous masses, pure white in colour, not exceeding the width of two laths of the lattice, and hanging, as it were, in the clear aqueous, giving one the impression that they are floating bodies, but on long continued examination under the slip-lamp it was found that every one of the lumps was fixed and immobile.

These white masses that were fairly well distributed in Descemet's membrane were absent in the younger members and, in fact, the appearance of the dystrophy was of the pure nodular variety.

The macroscopically clear corneae of the youngest members showed the commencing dystrophy in the form of superficial punctate keratitis, the curdy spots being mostly on the corneal nerves.

None of the members showed hypotony and all of them are females.

Patient N. only consulted me regarding her headache and photophobia. The others have no symptoms and were brought for inspection on my request.

Parents (no eye trouble).

Name	R. (a widow)		N.	S.
Age	40		37	30
Variety	lattice-shaped		lattice-shaped	lattice-shaped
Vision	R. 6/36 L. 6/18		R. 6/18 L. 6/24	6/18 B.E.
				R.
Name	(no issue)	C.	R.	N.
Age		13	10	6 6
Variety		Groenouw's nodular	Groenouw's nodular	K.P.sup. K.P.sup.
Vision		B.E. 6/6 pt.	B.E. 6/6 pt.	6/6 6/6 B.E. B.E.

All females.

AN INTERESTING PHENOMENON IN A CASE OF ECTOPIA LENTIS

BY

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MADRAS

AN obese girl of the age of 11 years was brought to my office with symptoms of failing vision. She is an offspring of consanguinity with no other characteristic history. On examination, the right cornea had a nebula near the lower quadrant, said to be due to an attack of small-pox. The pupils of both eyes were rather eccentrically situated and very active, disclosing on dilatation two areas, one clear and the other whitish. The iris was very tremulous in both eyes. The chambers were quite deep and of equal depth throughout. Tension $\bar{c}$ Maclean's tonometer was 70 mm. in the right and 60 mm. in the left eye. Vision : R.E. = 0 and vision in the L.E. = 6/24 $\bar{c}$ + 10·0 D. sph.

The lenses had the whiteness of a thin ricewater congee, were extremely tremulous and displaced downwards and inwards. The upward and outward aphakic area of the dilated pupil, admitted easily of an ophthalmoscopic examination which revealed a pale disc in the left eye and a pale and cupped disc in the right sightless eye. The same area showed, under the slit-lamp, parallel strands of zonular fibres, each fibre having two to five iridic knots on it. No fibre was loosely hanging—being firmly attached at either end. Just as I was finishing the examination, a doctor friend entered and I asked him to have a look at the interesting case. He quickly remarked that the lens in one eye was in the anterior chamber and to my surprise I did find in one eye the lens had wandered into the anterior chamber, now looking very much like an airbubble—rather a flat air bubble, with a sparkling edge, absolutely immobile, fixed in front of the pupillary area. This phenomenon lasted only for a few seconds, the lens wandering back to its first position of dislocation. Nevertheless, I once succeeded in dislocating it in one eye into the anterior chamber by keeping the head in the prone position for a long time, but failed to continue to keep it there for any appreciable length of time, even by throwing the head forward for a long time and by trying to render the pupil contracted by eserine, subsequent to its dislocation anteriorly. I saw the phenomenon occurring in both eyes on independent occasions. This has been observed by the mother on several occasions only during the last seven months, though she says that for weeks it sometimes does not occur. The patient is conscious of the event by the probable changed character of the vision. The unfortunate part of the whole case is this evanescent

sojourn of the lens in the anterior chamber and the total impossibility of binding the wanderer there by any ophthalmological trick, sadly disallowing the study of the lenticular border under the slit-lamp.

ABSTRACTS

I.—CORNEA

(1) **Bauer, A. (Vienna).—The origin of Krukenberg's spindle. (Zur Genese der Krukenberg-Spindel).** *Zeitschr. f. Augenheilk.*, Vol. LXXIII, p. 360, 1931.

(1) **Bauer** reports two cases of Krukenberg's spindle and critically reviews the literature on the subject. A tabulated summary of the findings in published cases is given. The association of Krukenberg's spindle with myopia, adult life, female sex and familial disposition is stressed. Persistent pupillary membrane and other malformations that have been observed are regarded as coincidences. No evidence for any congenital origin of the condition is found. The conflicting views as to the site of the pigment, whether in front of, or behind the endothelium are discussed. That pigment deposits in the cornea may occur apart from Krukenberg's spindle is pointed out.

On the nature of the pigment, Bauer finds no support for the view that it is haematogenous in origin. He holds that it is derived from the melanin so abundantly present in the pigmented tissues of the eye, the pigment being liberated by chronic degenerative processes. Once it is freed it is only a matter of physics to explain the characteristic appearance of the spindle. Ehrlich's experiment in injecting fluorescein into the ear-vein of a rabbit and seeing it trickle down in the anterior chamber as a centrally placed vertical line is recalled, as is Türk's further work showing this phenomenon to be based on convection currents induced by slight differences in temperature. Given a very slow entry of pigment cells into the fluids of the eyes, the differences in temperature between the anterior chamber and vitreous (up to 5° according to Michel and Silex) is more than enough to set up convection currents (only 2/10° being necessary according to the author's experiments). The formation of the spindle is facilitated by a slowing down of the convection current, and also by the deep anterior chamber seen in high myopia and megalo-cornea. Physiological bedewing of the endothelium in the pre-pupillary area, shown to be present in about 50 per cent. of children (Lüssi), is another factor which helps the deposition of the pigment.

ARNOLD SORSBY.

(2) **Poe, David L. (New York).—Kayser-Fleischer ring in the cornea in a case of Wilson's disease.** *Amer. Jl. of Ophthal.*, December, 1930.

(2) **Poe's** patient was first seen at the age of 21. He had a circular brownish green pigmentation which extended round the cornea at the limbus. The pigment, by slit-lamp examination, was found to be located in Descemet's membrane. The ring was about 2·5 mm. broad and shaded gradually into the normal cornea. Examination with the gonioscope showed that the abnormal pigmentation was limited to the cornea and did not involve the sclera, iris or other structures. The lens appeared to be unaffected, though other observers have found in this disease the so-called Purtscher pseudo-cataract. This is a very delicate, shimmering membrane, situated in the anterior capsule of the lens and visible only by oblique illumination. It is said to be pathognomonic of the presence of copper in the eye. While there is no accepted explanation of the pathological processes which bring about pigmentation of the cornea, it is thought that the material responsible is derived from substances which are washed into the circulation in the course of the cirrhotic destruction of the liver. The same substances are probably responsible for the degenerative processes taking place in the lenticular nuclei. Special investigations were made in the present instance for evidence of icterus, but nothing very definite was found except that the van den Bergh test gave an increase in the icterus index. With regard to the general condition, the patient showed tremors of which the coarseness and severity were variable, the face was immobile and stiff and the fingers made pill-rolling movements. The arms were rotated inwards, the legs extended and at times spasms of the hips involved the flexors of the joints so that the extended legs were raised from the bed. The arms and legs were hypertonic, the ocular movements markedly limited, and the vestibular reactions to caloric tests exaggerated.

F. A. W-N.

(3) **Towbin, B. G. and Rawic-Scerbo, W. A. (Woronsch).—On the relation of scrofulous kerato-conjunctivitis to tuberculosis. (Zur Frage der skrofulösen Keratoconjunctividen zur Tuberkulose).** *Arch. f. Ophthal.*, Vol. CXXIV, p. 154.

(3) This research was carried out on a series of thirty patients, varying in age from 10 to 45 years.

These patients were found to be all affected with tuberculosis and all highly sensitive to tuberculin. In none could any relation between the type of the tuberculous process in the lung and the character of the ocular disease be observed. The von Pirquet reaction in 20 cases was of the exudative type, while in the others it was hyperaemic-normallergic and hypallergic.

In 14 cases subcutaneous injection of old tuberculin was followed by a focal reaction in the eye. This reaction occurred only when the eyes showed either phlyctenules at the limbus and on the ocular conjunctiva, or more or less diffuse opacities of the cornea. It occurred too only in acute cases, so that there was an undoubted connection between the degree of sensitiveness of the eye to tuberculin and the degree of activity and character of the scrofulous disease.

The occurrence of a reaction in the eye coincided with that of the exudative type of the von Pirquet reaction, which indicated a certain parallelism between the degree of sensitiveness of the eye to the general tuberculin-intoxication and the degree of the skin sensitiveness to the local action of the tuberculin. There was also a certain relation between the character of the von Pirquet reaction and the type of the eye affection.

As regards the allergic state of these patients it was found that in practically all the sensitiveness of the affected eye to tuberculin varied in conformity with the general tuberculous-anaphylactic sensitiveness to this virus.

In all probability the scrofulous lesions in the eye are sensitized with living tubercle bacilli which later disappear from the eye, while relapses of the disease depend on the anaphylactic sensitiveness of the previously affected parts to tuberculin, which comes from the pulmonary or other, even though inactive, tuberculous foci.

From the results of this research **Towbin** and **Rawic-Scerbo** feel justified in their view of the tuberculous-allergic character of scrofulous keratoconjunctivitis, which they include among the tuberculides.

THOS. SNOWBALL.

II.—UVEA

(1) **Finoff, William C. (Denver).—Tuberculosis in the etiology of acute iritis.** *Amer. Jl. of Ophthal.*, February, 1931.

(1) **Finoff's** paper opens with an allusion to the rarity of this condition, since tuberculosis is essentially a chronic disease. It does happen, however, that the nodular form of tuberculous iritis is sometimes preceded by a diffuse, acute iritis and it is therefore conceivable that in some cases of this lesion, recovery may occur before the development of nodules. Vigne had a singularly well attested case of recurrent acute iritis, in which he performed iridectomy, hoping to cure the condition. The excised iris was introduced into a guinea pig with a positive result, and the patient's iritis progressed to the nodular form, the patient himself eventually dying of general tuberculosis.

F. A. W-N.

(2) **Moore, Joseph Earle (Baltimore).—Syphilitic iritis.** *Amer. Jl. of Ophthal.*, February, 1931.

(2) **Moore's** paper is a valuable contribution to the literature on this subject and contains observations of 249 patients under his care. Of these. 111 had early secondary syphilis, 29 had recurrent secondary syphilis, and 109 late syphilis. In general, iritis is twice as common in coloured patients as in white. It occurs in 4-5 per cent. of secondary syphilis, about twice as frequently as a manifestation of recurrent syphilis and is fairly common in late syphilis. The Wassermann reaction of the blood is positive in 97 per cent. of the early cases of iritis, in 55 per cent. of the recurrence cases and in 81 per cent. of the late cases. The history and results of general clinical examination are therefore of great importance in the last types of case. Spinal fluid findings indicate that neurosyphilis is more common in patients with iritis than in those without it, which suggests a similar explanation for the two diseases, viz., that the tissues of the central nervous system and of the uveal tract do not have an opportunity of developing their natural resistance owing to the institution of antisyphilitic treatment which cuts short the normal inflammatory responses. A few spirochaetes are left, however, and these develop, as it were, on virgin soil, though the other tissues of the body, on account of their quicker reaction are already at any rate partially immune before treatment is instituted. For this reason, among others, the author recommends a year's full treatment without any intermissions, after the Wassermann reaction of the blood and cerebro-spinal fluid have become negative. While most of the cases of early iritis had easily recognisable associated lesions of secondary syphilis, 25 per cent. had lesions so insignificant as to be easily overlooked. In late iritis only 50 per cent. of patients showed other manifestations of syphilis. Recurrent iritis usually appears within four months after the inadequate treatment of early syphilis, and late iritis about nine years after infection. The diagnosis of this condition is frequently missed, and many patients lose teeth, tonsils, and appendix before even a Wassermann reaction is done. The diagnosis of a non-syphilitic cause for iritis in a syphilitic patient is necessarily difficult, though Zimmerman estimates that 6-7 per cent. of cases are of this nature. The therapeutic test is the most reliable one, but there are two fallacies. (1) That certain syphilitic lesions, particularly those of the cornea, are difficult to cure as quickly as those occurring elsewhere; (2) That the arsenical preparations exercise a markedly beneficial effect on non-syphilitic eye disease. Repeated relapse is frequent in late syphilitic iritis, but not in the early form, and the same is true of secondary glaucoma. The results of treatment were good in 70 per cent. of patients in the early group, 58 per cent. in the recurrent group and in 42 per cent. in the late group.

F. A. W-N.

(3) **Gifford, S. R. (Chicago).—A review of the literature on the etiology of acute iritis.** *Amer. Jl. of Ophthal.*, February, 1931.

(3) **Gifford's** article consists largely of a resumé of various papers on this subject, supplemented by a tabular analysis of the causes of acute iritis among his own cases. The latter comprise 118 seen in private during the last ten years and the percentages are as follows:—syphilitic 16·9, tuberculosis 8·5, gonorrhoea 6·8 (prostatic 5·1, pelvis 1·7), tonsillar 22, dental 12·7, sinus infection 6·8, diabetic 1·7, undetermined 32·6 (8·5 combined infection, 16·1 no cause found). It is interesting to note that most of the cases in which a supposed cause was not removed, did not have recurrences. In Brown and Irons' series, however, where 50 cases had been followed for 3—12 years, 43 remained free of recurrence after removal of the supposed cause, although 23 of these had had several attacks before. In continental statistics, tuberculosis is a more aetiological factor. A typical figure is that quoted by Gilbert, 45·6 per cent. cases of iritis due to tuberculosis and only 2·8 per cent. due to focal infection. Gifford explains this discrepancy as due to three causes (1) that many of the continental cases are serous iritis; (2) that the majority of American reports concern private cases in which the incidence of tuberculosis would be lower; (3) mistakes in diagnosis; the tendency, in America, being to overemphasize the importance of focal infection and on the continent of tuberculosis. Various papers are quoted on the subject of elective localization. Some of these give positive and others negative results, a typical positive one is that of Benedict who used streptococci from 14 cases of iritis, chiefly from dental foci for intra-venous injection into rabbits. Five of these cases had acute iritis and material from four of them produced iritis in the rabbits, while that from the nine chronic cases caused no iritis. Back, on the other hand, injected 14 animals with streptococci from cases of iridocyclitis without producing any ocular lesions.

F. A. W-N.

(4) **Merrill, H. G. and Oaks, L. W. (Provo, Utah).—Uveoparotitis. (Heerfordt).** *Amer. Jl. of Ophthal.*, January, 1931.

(4) The credit of first describing this disease probably belongs to Heerfordt, who in 1909 reported three cases observed in Copenhagen during 1905 and 1906 though cases with similar symptoms had been described in 1889 and 1903. The aetiology is still in doubt, syphilis, tuberculosis, mumps, diphtheria being some of the causes invoked by various writers. **Merrill** and **Oaks** consider that the weight of the evidence up to date points to the cause being "some specific virus, bacterium or agent, as yet unknown." An equivocal statement which is true of many diseases of unknown

aetiology. The symptoms comprise uveitis showing a great tendency to the formation of synechiae and deposition of pigment on the cornea; bilateral, usually painless swelling of the parotid glands and a low grade chronic fever manifest during the first half of the disease. Frequent concomitants are, paralysis of the cranial nerves, particularly the seventh, a prodromal rash like erythema nodosum, marked dryness of the mouth, polyuria, prodromal malaise and sleepiness and paresthaesiae and pareses in other than the cranial nerves. In a few instances the lacrimal glands and the submaxillary glands may be swollen. The case reported by the authors occurred in a woman aged 43 years, who showed the ordinary symptoms, though the parotid swelling lasted for the unusually long period of two years and ten months and the fever (up to 100° F.) for two months. The latter subsided after withdrawal of two litres of straw-coloured pleural effusion. Although all tests were negative—including skin tests and X-ray examination for evidence of tuberculosis, the authors consider that tubercle should be considered as a possible aetiological agent in production of the disease. The paper contains a tabulated resumé of 30 cases culled from the literature.

F. A. W-N.

III.—RETINA

(1) **Hanssen, R. (Hamburg).—The anatomical changes in disciform degeneration of the macula. (Zur Anatomie der scheibenförmigen Degeneration der Netzhautmitte).** *Zeitschr. f. Augenheilk.*, Vol. LXXII, p. 360, 1930.

(1) From a microscopic examination of both eyes removed from a man, aged 81 years, who during life had shown fully developed typical disciform degeneration of the macula in one eye, and the early stage in the other, **Hanssen** holds that the primary lesion is in the chorio-capillaris, and not in the retinal vessels as Junius and Kuhnt believe. In the retina he found perivascular collections of lymphocytes, but the vessel-walls themselves were intact. That these collections of lymphocytes had any bearing on the macular lesion is excluded by the fact that they were more numerous at the periphery than centrally. In the chorio-capillaris, groups of lymphocytes were confined almost entirely to the macular region, and associated with these were marked vascular changes, together with secondary changes in the surrounding tissue. In broad outlines, Hanssen's findings agree with those of Behr (*Zeitschr. f. Augenheilk.*, Vol. LXIX, p. 1).

Hanssen draws attention to cases simulating disciform degeneration of the macula, which on microscopic examination show extensive degeneration over the whole of the retina, with heavy involvement of the retinal vessels. These cases are best considered a separate group, having only superficial resemblance to the group described by Junius and Kuhnt. Likewise disciform degeneration can be simulated by an old traumatic hole at the macula, causing glial proliferation, as illustrated by one of the excellent microphotographs accompanying this article.

ARNOLD SORSBY.

(2) **Parker, Walter R. and Culler, Arthur, M. C. (Detroit).—Lipemia retinalis.** *Amer. Jl. of Ophthal.*, July, 1930.

(2) **Parker** and **Cullen** have seen two cases of this disease and have had the opportunity of making some valuable observations. The first case was a young farmer with mild diabetes who had been on a high fat diet and came to the clinic in acidosis. His fundi showed typical lipaemia and the total fat content of the blood was 11·6 per cent. The fundi became normal in 16 days under insulin treatment, although the fat percentage was still 2·26. The patient was then put on to a high fat diet for 26 days without demonstrable change in the fundi, thus controverting the theory that lipaemia is due to fat in the diet. For 27 days he was allowed to develop a gradually increasing glycosuria which again caused no lipaemia. When, however, acidosis supervened he developed lipaemia when the blood fat was 3·65 per cent. This disappeared rapidly with the use of insulin. The second case occurred in a diabetic in acidosis whose blood contained 4·28 per cent. of fat. The lipaemia disappeared after nine days of insulin treatment, when the acetonuria had also disappeared and the blood fat had fallen to 2·83 per cent. He was allowed to redevelop acidosis and at the end of a week the blood lipoids had risen but not sufficiently to produce lipaemia. The following observations were made from a consideration of 37 cases recorded in the literature. Males are more affected than females, the proportion of the former being 86 per cent. The average age is 25 years, the youngest case being nine and the eldest 50, only one showed retinal haemorrhage. There is great disparity in the recorded percentages of blood lipoids, due to differences in the methods used. The normal is probably 0·4 per cent. to 0·5 per cent. and one observer has found as much as 48 per cent. of fats in a case of lipaemia. Every case in the literature except one had diabetes and was probably in acidosis, the exception was a boy who had X-ray treatment for leukaemia. Of 18 cases in which insulin was not given, only one recovered, while of 15 cases treated by insulin only one died. The

prognosis is not therefore affected by the development of this complication, except in so far as it points to the disease being of a severe type.

F. A. W-N.

(3) **Calhoun, F. Phinizy (Atlanta).—Observations on the formation of macular star in nonrenal cases.** *Amer. Jl. of Ophthal.*, 1931.

(3) **Calhoun** emphasizes by the description of six cases, the truth of Frost's statement "that our present knowledge of retinal exudates points to the conclusion that identical ophthalmoscopic appearances may be due to different pathological processes." The cases were briefly as follows:—(1) "Bilateral neuroretinitis" with reduction of vision to 20/2,000 in each eye, and symptoms pointing to acute hyperpituitarism. There was a complete star figure at each macula, and some exudate in the retina surrounding the discs. Within two months vision had returned to normal, and the exudates had almost entirely disappeared. (2) Bilateral neuroretinitis with complete star figure at each macula, in a case of nephritis due to pregnancy. An interesting feature in the case was the presence of numerous glistening punctate spots in the deeper layers of the retinae, extending far out to the periphery. (3) "Bilateral papillitis" with a macular star in a case of hypophyseal syphilis. It was notable that the star figure increased in the right eye as the oedema of the disc and retina subsided, after decompression and ventricular drainage. (4) Unilateral neuroretinal oedema with a macular star, due probably to partial venous thrombosis and endocrine imbalance. (5) Bilateral papilloedema and macular stars probably due to a cerebellar tumour. In this case, the star figures appeared the day after spinal drainage had been performed, when the swelling of the discs was beginning to become less. (6) Concussion injury of the eye with commotio retinae and formation of an incomplete macular star.

The mode of formation of the star is a matter of controversy, and Marcus Gunn's explanation would still appear to hold the field. He argued that as the retina is, so to speak, pegged down at the fovea, any distension of the thick surrounding portion will tend to produce fine folds radiating from the fovea. If exudates form, they will tend to be deposited along the lines of these folds, and produce a star. Oedema of the retina is thus a prerequisite for its formation. If the oedema be generalized, a complete star figure will result, but if it be localized, only a few radii will appear. An example of this latter is seen in the well-known macular fan, occurring in conjunction with papilloedema of sudden origin, when the oedema spreads out towards the fovea from the temporal edge of the disc, and there results a fan-shaped figure, and not a complete star.

F. A. W-N.

IV.—MUSCLES

(1) **Peter, Luther C. (Philadelphia).—Tendon transplantation for paralysis of the superior rectus.** *Amer. Jl. of Ophthal.*, October, 1930.

(1) **Peter's** case occurred in a patient recovering from Graves' disease who had a residual palsy of the left superior rectus muscle. The operation was performed under local anaesthesia and consisted in the following procedures. (1) Advancement of the paretic muscle. (2) Splitting of the internal and external recti for 12 mm. and attachment of the superior halves of these muscles to the internal and external borders of the superior rectus stump. (3) Recession (3 mm.) of the inferior rectus. The result was that the patient could rotate the left eye upwards 22° above the horizontal, though there was still some hyperphoria. The author has operated by similar method on five cases of external rectus paresis and has had varying results from central fixation, to 25° of external rotation. He is of opinion that at least half of each tendon should be transplanted, that the paralysed muscle should be very freely advanced, and that a complete tenotomy or a recession should be performed on the muscle antagonistic to the paralysed one.

F. A. W-N.

(2) **Adler, Francis Heed Adler (Philadelphia). — Reciprocal innervation of the extra-ocular muscles.** *Arch. of Ophthal.*, March, 1930.

(2) **Adler's** paper opens with a short review of the literature on the subject, and an account of some of the work done by Sherring and by de Kleyn. The latter removed an eyeball in a decerebrate rabbit and connected the internal and external recti to recording levers. Irrigation of the ipsolateral labyrinth caused a slow contraction of the external rectus and a corresponding relaxation of the internal rectus followed by a sudden contraction of the internal rectus. The author then goes on to describe two cases which appear to show evidence of reciprocal innervation in the extra-ocular muscles. The first was a case of bilateral paralysis of the third and fourth cranial nerves, with consequent divergent strabismus when the lids were raised. When directed to look, say to the right, the right eye moved outwards and the left to the middle, even after thorough injections of procaine hydrochloride into the left internal rectus. This movement was interpreted as being due to relaxation of the external rectus of one side when that on the other contracted. The second case was one of paralysis of the third and fourth nerves of the left eye in which the left eye moved towards the mid-line when the right eye was abducted.

F. A. W-N.

V.—GENERAL MEDICINE

(1) **Margotta (Rome). — Ocular complications in alcohol-poisoning. (Ricerche Cliniche Sulle Complicanze Oculari nell'Intossicazioni Alcoolica).** *Ann. di Ottal.*, January, 1931.

(1) **Margotta** has investigated the acuity of vision, both central and peripheral, together with the limits of the visual field, in a number of cases of delirium tremens alcoholicum, whom he examined in the Asylum at Padua. Many of these had suffered from repeated attacks. The fundus changes have been slight or wanting, but the functional changes have been considerable; in the majority, Margotta found contraction of the visual field especially in the vertical meridian, both above and below. The peripheral acuity was reduced almost proportionately to this loss. He never found any central or paracentral scotoma.

HAROLD GRIMSDALE.

(2) **Rossi (Naples).—Familial macular degeneration associated with calcification of the dura mater, and the epiphysis. (Degenerazioni Maculari Retiniche Famigliari Associate a Calificazioni della dure Meninge e della Epifisi).**

(2) The family, whose history is reported by **Rossi,** consists of seven sisters. Of these, six presented some retinal change; four of these were comparatively slight and concerned the macular region only, allowing considerable vision and not apparently increasing in extent; in two there was extensive degeneration of the peripheral region, with contraction of the visual field and continued deterioration of vision.

In four of the sisters X-ray examination showed calcareous plates in the neighbourhood of the epiphysis.

Though the parents of the family showed no signs of syphilis, Rossi concludes, from the history of the maternal grandfather that the real cause is hereditary syphilis of the third generation. (No indication of name of journal).

HAROLD GRIMSDALE.

(3) **Maxwell, E. M.—A note on cases of hypermetropia developing during treatment in diabetes mellitus.** *The Irish Journal of Medical Science*, April, 1931.

(3) **Miss Maxwell** gives the details of five cases of diabetes in which a rapid decrease in the refractive power of the eye followed a decrease in the blood sugar content. In four of the cases, treatment was by insulin injection—in the fifth, a sudden starvation for two days produced the changes in refraction. No one of the cases showed definite signs of hypoglycaemia and in the course of a few days vision returned to its normal level.

A. E. J. LISTER.

(4) **Friedenwald, Jonas S. (Baltimore).—Pigmentary degeneration of the retina in cerebrospinal syphilis.** *Amer. Jl. of Ophthal.*, November, 1930.

(4) **Friedenwald's** cases are of interest, in that they represent a type of late syphilis in which antiluetic treatment has been relatively successful. The paper contains reports of three cases of tabetic optic atrophy with considerable field loss and associated retinal changes. The latter were of the kind usually seen in congenital syphilis and bore a strong resemblance to retinitis pigmentosa.

In two cases, vigorous anti-syphilitic treatment with arsenic and bismuth injections resulted in checking the progress of the optic atrophy and in bringing about some absorption of the pigmented areas. The third case refused treatment. The author concludes that " the nature of the bodily reactions (allergy and immunity) to the spirochaete of late neuro-syphilis resembles that found in congenital lues."

F. A. W.-N.

BOOK NOTICES

Transactions of the American Ophthalmological Society. Vol. XXIX. 1931.

The Sixty-seventh Annual Meeting of the American Ophthalmological Society was held at Ashville, N.C. The *Transactions* of this meeting are recorded in a volume of 591 pages, including the index, and the papers reflect a high standard of scientific and clinical work in ophthalmology and allied sciences. There are 78 full page illustrations and photographs, mostly in monochrome, but some in colours, together with diagrams, drawings, charts, and tables in the text.

A list of the officers and council of the American Ophthalmological Society is given, also the presidents, members, and Emeritus members. Four obituary notices precede the minutes of the proceedings.

There are many papers on subjects of current interest, and these will be abstracted in greater detail and published at a later date. Davis (Madison, Winconsin) has made a contribution to the literature of avertin as an anaesthetic in ophthalmic surgery. He reports his experience with 90 cases, 48 intra-ocular operations, and 42 extra-ocular. The method of preparation, dosage, administration, dangers, after-effects, complications and contra-indications are described faithfully. He believes that avertin is a valuable adjunct

for use in selected eye operations, where local anaesthesia is not satisfactory.

'O'Brien (Iowa) has contributed a long paper on cataract of post-operative tetany. He reviewed 42 reported cases of this disease and added three from his own experience. The cataracts develop with either manifest or latent tetany, and progress despite all treatment which may control other manifestations. It seems that the first lens changes appear as aggregations of fine, opaque granules directly under the anterior and posterior capsules of the lens. Delayed spontaneous haemorrhage may occur after lens extraction. O'Brien advocates that the patient be given a parathyroid hormone, viosterol, and a high calcium intake before and after operation.

Gradle (Chicago) read a short paper on cyclodialysis in simple glaucoma. He concludes that this operation offers chances of success in 80 per cent. of cases provided the indications for the use of the operation are adhered to.

Jonas S. Friedenwald and Pierce (Baltimore) gave a preliminary report of their work on the circulation of the aqueous, its rate of formation, source, outflow and the biochemical problems produced by the variations of its constituents. A. Magitot (Paris), Kronfeld (Chicago), Yudkin (New Haven) and Verhoeff (Boston) discussed this paper. Kirby (New York) read a long paper on the anterior vitreous in health and disease.

Samuels (New York) has made an interesting study of the epipapillary tissues, and his paper is illustrated by several excellent drawings of microscopic sections. de Schweinitz gave a communication on blindness and papilloedema in Guernsey calves, usually bulls, including the results of post-mortem examination of two of the affected animals. He discusses pre-natal influences, familial disease, inbreeding, toxaemia and food poisoning as aetiological factors.

Hardy (New York) read a long paper on scotometry, in which he outlined the history and technique of this method of examination. This paper is very full, and there are numerous photographs, graphs, diagrams and charts, together with 258 plates.

Handbuch der Gesamten Augenheilkunde. Begründet VON A. GRAEFE und TH. SAEMISCH. Fortgeführt VON C. HESS. Zweite, neubearbeitete auflage. II Teil. V Band. Kapitel VI 2. Die Erkrankungen des Uvealtraktus. von W. Gilbert, Professor in Hamburg. Julius Springer. 1931. Price R.M. 59.60.

This section dealing with diseases of the uveal tract has been revised and brought up to date by Professor W. Gilbert (Hamburg). The book consists of 254 pages, and there are 77 illustrations in the text, most of which are coloured. These illustrations show

ophthalmoscopic conditions affecting the choroid and retina, and the morbid anatomy and histology of the diseases of the uveal tract; they are well produced.

At the end of each chapter an exhaustive literature is given, ranging from 1852 to 1929. 63 pages are devoted to a description of the pathology of tuberculous uveitis, and 32 pages to syphilitic lesions in the uveal tract. Much painstaking work has been put into this book, and the author has searched widely in the literature of this subject. The book is well printed on good paper, and the illustrations are excellent.

Cirurgia Ocular. By Dr. W. BELFORT MATTOS. Sao Paulo, Brasil. 1931.

The first volume of a system of ophthalmic surgery by Dr. Belfort Mattos, of Brazil, provides a résumé of the operative procedures which he employs, together with short descriptions of illustrative cases. In the extraction of cataract he induces akinesia of the lids, uses capsulotomy forceps, and practises a simple extraction with a corneal stitch. For corneal leucomata, optical iridectomy and tattooing are described. For acute glaucoma, a retrobulbar injection of novocaine is advised, and a von Graefe's iridectomy employed; for chronic glaucoma, a modification of the sclerectomy and iridectomy of Lagrange. A considerable section is devoted to the surgical treatment of cysticercus, and the remainder of the book is occupied by plastic surgery of the lids and orbit. There are no references to the literature, and the operative procedures practised by the author are described alone without the discussion of any other alternatives. These, however, are described simply and clearly, and on the whole his teaching is sound. The book is beautifully printed, and well illustrated; the only exceptions to this are figures 8 to 19, which show sections of a cinematograph film of an operation for cataract, but these are so small as to be quite unintelligible, and are printed on a grain so coarse as to render magnification useless.

Ueber den Augendruck und die vorderen Intraokularen Gefässe. By SVEN LARRSON. Stockholm. 1930.

An extremely interesting and valuable piece of research on a branch of ocular physiology of which far two little is known and which is of the greatest importance in the clinical treatment of many diseases of the eye is presented by Sven Larsson, of Stockholm, in a monograph entitled "Ueber den Augendruck und die vorderen Intraokularen Gefässe." His researches are partly experimental on rabbits and partly clinical on human subjects and are directly inspired by the work of Sir Thomas Lewis and Sir Henry

Dale on the reactions of the smaller blood vessels. He has studied the behaviour of the smaller vessels—arterioles, capillaries, and veins—in the anterior segment of the globe after stimuli such as trauma and compression of the globe, the subconjunctival or intra-ocular injection of saline and adrenaline, and the administration of eserine and atropine. His observations include the direct examination of the vessels of the iris, the determination of the permeability of their walls by noting the point at which they allow dyes to pass from the blood stream to the eye, and tonometric measurements of the intra-ocular pressure. The work has been carefully done, and corroborates many previous observations: thus he finds that after the instillation of eserine into the conjunctival sac of the normal eye a short primary phase of vaso-dilatation and raised intra-ocular pressure is followed by a more lasting phase wherein the vessels of the anterior segment are constricted and the intra-ocular pressure falls. Similarly atropine is found to dilate the capillaries, but he finds that its action on the pressure on the normal eye is variable and cannot be predicted; it may be that the variability in his results are due to the uninvestigated factor of its effect upon the smooth muscle surrounding the globe. The concluding part of the monograph deals with the effect upon the eyes of rabbits of operative procedures such as paracentesis, iridectomy and cyclodialysis, and the differences in the reactivity of the blood vessels in such eyes compared with the normal. The whole forms a very interesting piece of work, carefully reasoned out and well executed.

Kurzes Handbuch der Ophthalmologie. Auge and Nervensystem. Julius Springer. 1931. Price, 148 R.M.

The sixth volume of the *Kurzes Handbuch der Ophthalmologie* is devoted entirely to the eye in its relationship with the central nervous system. It seems anomalous that a large volume of 878 pages in a work which purports to be a short handbook should be entirely devoted to this part of the subject, and certainly the reader cannot complain of lack of elaboration of detail. It is true that there is a certain amount of overlapping which is always a danger in works of composite authorship; thus much of the anatomy is again described although it has already been very fully dealt with in the first volume; deformities such as cyclopia are described and illustrated although they have been fully noticed in the volume which includes congenital anomalies; while in the present volume several conditions are described and re-described by different authors; nevertheless, although perhaps overloaded with detail and containing minute descriptions of several conditions with little immediate ophthalmological interest, the book is an extremely valuable one and unique of its kind.

The first section by Professor Wohlwill, of Hamburg, deals with the pathology of the base of the brain, the basal nuclei, the meninges, the pituitary, the cerebrum, and cerebral tumours. The second by Drs. Bing and Franceschetti, of Basel, is concerned with the pupil, and gives a very useful account of the physiology, pharmacology and pathology of its reactions. The next section by Professor Behr, of Hamburg, deals with the affections of the oculo-motor nerves, their nuclei and central connections, as well as those of the fifth, seventh, and sympathetic. Professor Behr contributes a further section on the pathology of the visual tracts proximal to the chiasma, in which he pays special attention to the effects of cerebral tumours, and the story is continued through the upper visual paths and centres by Quensel, of Leipzig. The latter part includes very useful sections on the different manifestations of aphasia, agnosia and migraine. Two comprehensive sections then deal with the visual manifestations of non-inflammatory and inflammatory disturbances of the central nervous system, the first by Professor Best, of Dresden, and the second by Dr. Kyrieleis, of Würzburg. The last and not the least interesting section of the volume, by Professor Weber, of Chemnitz, deals with psychoses, neuroses, and hysterias. As is the case with the earlier volumes, the present section of the handbook is extremely well printed and illustrated, elaborate in detail, and encyclopaedic in nature; but, while being a valuable addition to reference literature, somewhat misleads the prospective purchaser by its title as part of a short handbook.

A Survey of Sight-Saving Classes in the Public Schools of the United States. EDWARD T. MYERS, PH.D. Reprinted from the April, 1930, *Sight-Saving Class Exchange.* Price, 50 cents.

Sight-saving classes are an outgrowth of the problem of educating children who are not blind, but possess too little vision to profit by the traditional school procedure. It is interesting to note that this movement began in England in 1908, when a myope class was established in the Boundary Lane School, London. About 1889, Dr. J. H. Bell, surgeon to the Bradford Royal Eye and Ear Hospital, stated that myopes needed special educational provision, and at the International School Hygiene Congress in London in 1907, Mr. Bishop Harman discussed this subject. The movement spread to America, where the first class was established in Boston in 1913. Since then there has been a rapid growth in the number of classes, until in 1928 there were 319 classes in 87 communities, in 21 states.

Dr. Myers' purpose in making this exhaustive and detailed study

was to present a national survey that would be of value to the teaching profession already engaged in sight-saving class work, and to educationalists in general.

The sight-saving classes are planned to instruct the pupils with the minimum of eyestrain, to teach them to conserve the vision they possess, and to provide such vocational guidance, and, if necessary, vocational training as will enable them to fill the most useful places in the community that their powers will permit.

Authorities differ concerning the probable number of visually handicapped children which might be expected in any school system. The two most commonly expressed ratios of such children to the total school enrolment are 1 to 500 and 1 to 1,000.

The standards for admission of children to sight-saving classes varied greatly in different communites. Dr. Myers comments on the inadequacy of sight-saving class provisions in rural districts. Investigations were made into the general health of children attending these classes, and in the opinion of the teachers it showed no great variation from the normal.

The four most frequently mentioned eye defects are myopia, hypermetropia, nystagmus and astigmatism. Myopia, combined with other defects, comprised 38·9 per cent. of all those attending these classes.

Over 90 per cent. of the children who had received two vision tests, one on entering the school and another at a later date, had the same or better vision at the time of the second test, but 9·4 per cent. had poorer vision when retested.

Intelligence quotients based on the teachers' judgments gave conflicting and unreliable data. In some instances, the intelligence was stated to be below normal, and in others, the mentality of these children was assessed as above that of the average normal child of similar age.

Half the pupils were enrolled in the sight-saving classes before the age of 9 years and 5 months. Enquiries were made into the promotion rate, and an endeavour made to grade the school subjects in order of proficiency. Reading was mentioned as the best subject in 2·2 per cent. more cases than it was mentioned in the poorest subject. Investigations into the social strata from which the children came were also made.

This book consists of 105 pages, 5 chapters, 35 tables illustrating statistics, and 5 figures. At the end, 3 pages are devoted to the bibliography of this subject, and there is an appendix showing child information sheets and teacher information sheets.

Dr. Myers has taken great pains to collect a mass of statistics that will be of interest to the teacher, social worker, and ophthalmic surgeon.

CORRESPONDENCE

THE EGYPTIAN CAMPAIGNS, 1798-1807

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

SIRS,—It occurred to me while reading the proofs of Dr. Meyerhof's excellent paper, published in March, that it might interest our readers if I abstracted some of the information given, in Johnston's *Roll of Army Medical Service*, about the various English surgeons who are mentioned. Arranged in alphabetical order are the results of my researches.

DEWAR, HENRY. Assistant Surgeon, 30 Foot, 8 Jan., 1801. Hospital mate in the same regiment previous to being commissioned. Resigned 30 July, 1803.

FARRELL, CHARLES. Assistant Surgeon, Hompesch's Mounted Riflemen, 16 Nov., 1799: on half pay, 25 Oct., 1802: on full pay, 63 Foot, 5 Oct., 1804: Staff Surgeon, 2 Jan., 1806: Physician, 1 Aug., 1811: D.I.H. (brevet), 17 July, 1817: D.I.H., 9 Oct., 1817: I.H. (brevet), 27 May, 1825: half pay, 25 April, 1827: full pay, 15 Oct., 1829: I.G., 22 July, 1830. Retired on half pay 3 Aug., 1833. Born, 24 Aug., 1779. M.D.Edin., 1798. Died 15 Jan., 1855. Served in the Peninsular War.

MCGRIGOR, SIR JAMES. Surgeon, 88 Foot (by purchase). 25 Sept., 1793: R. Horse Guards, 9 Feb., 1804: D.I.H., 27 June, 1805: I.G., 25 Aug., 1809: Physician, Portsmouth Garrison, 13 June, 1811 (while I.G. Southern Command): half pay (special £3 a day), 25 Oct., 1814: full pay, D.G., A.M.D., 13 June, 1815 (ret. rank of Major-General, salary £2,000 a year): Retired on pension, 6 Feb., 1851: Served in Flanders, 1794-5: Grenada and St. Vincent, 1795-6: Egypt, 1801: Walcheren, 1809: Peninsular War, 1812-15 (Medal with 5 clasps). Knight Bachelor, 1814. Baronet, 1830. Physician Extraordinary, H.R.H. Prince Regent, 1816. Q.H.P., 1837. K.C.B., 1850. Turkish Order of the Crescent. Commander of Portuguese Order of the Tower and Sword. Born at Cromdale, Inverness, 9 April, 1771. Son of an Aberdeen Merchant. M.D., Aberdeen. 1804. LL.D.Edin., F.R.S., 1816. Rector of Aberdeen Univ., 1826, 1827, 1841. Died in London, 2 April, 1858.

MACGREGOR, SIR PATRICK. Assistant Surgeon, 11 Dragoons, 30 Aug., 1799: Coldstream Guards, 21 Nov., 1799: Staff Surgeon, 9 Feb., 1804: Surgeon, Royal Military Asylum, 9 Feb., 1804: Serjeant Surgeon to the King, and Personal Surgeon to H.R.H. the Duke of York. Baronet, 17 March, 1828. Died, 17 July, 1828. Hospital Mate previous to being commissioned. (In the London Gazettes and Army Lists either no christian name is given or he is named Peter.)

POWER, GEORGE. Assistant Surgeon, 23 Foot, 21 Dec., 1801: Surgeon, 23 Foot, 13 Nov., 1806: Staff Surgeon, 11 July, 1811: Retired on half pay, 25 Jan., 1816. Served in Egypt, 1801. Copenhagen, 1807. Martinique, 1809. Peninsular War. 1810-14. M.D., St. Andrew's, 1819. Hospital Mate, 11 March, 1801. Died at Bere Island. 18 April, 1824.

PYM, SIR WILLIAM. Surgeon, 70 Foot, 27 April, 1794: Garrison of Gibraltar, 3 Oct., 1799: Surgeon Major, Gibraltar, 17 Sept., 1801: D.I.H., 20 Dec., 1810: on half pay, 15 May, 1813: on full pay, I.H. (afterwards I.G.), 25 Sept., 1816. Retired, on half pay, 25 Sept., 1816. Served at Martinique, St. Lucia, Guadaloupe, 1794. Knight Bachelor, 1830. K.C.H., 1831. Born, 7 Jan., 1772. M.D., St. Andrew's, 1799. Regimental Mate, 35 Foot, 1792. Died in Harley Street, 18 March, 1861.

He was in medical charge at Martinique during the yellow fever epidemic of 1794-96, when it was estimated that 16,000 soldiers died. He was one of the few survivors of the wreck of the Athénienne in the Mediterranean in 1806. President, Board of Health, Malta, 1811-12. Superintendent General of Quarantine, 1826. Was at Gibraltar during the yellow fever epidemic of 1828. Chairman, Central Board of Health, cholera epidemic in England, 1832. Author of ***Observations upon Bulam Fever***, 1816.

REID (or REED), HENRY. Surgeon, 89 Foot, 1 Jan., 1799: 2 Dragoons, 16 Jan., 1817: on half pay, 27 Feb., 1817: died on his way to Ireland, 12 May, 1817: Hospital Mate, 26 Dec., 1796: Surgeon, Midlothian Dragoons, 2 March, 1798: Elgin Fencibles, 21 July, 1798.

VETCH, JOHN. Assistant Surgeon, 67 Foot, 6 Aug., 1806: 54 Foot, 25 Sept., 1806: 20 Foot, 30 April, 1807: Staff Surgeon, 25 Feb., 1808: Physician, 16 July, 1812: Retired on half pay, 25 July, 1816. Served in the Peninsular War, 1812-13. M.D.Edin., 1804. Hospital Mate previous to being commissioned. Died, 28 April, 1835.

WITTMAN, WILLIAM. Assistant Surgeon, R.A., 1797: Surgeon, R.A., 1794: Surgeon, O.M.D., Jan., 1804: Assistant S.G. and D.I.H., O.M.D., 1814. Died in Paris, 22 July, 1815. M.D.

The name of Arthur Edmonston does not occur in Johnston's "Roll." I suppose that he did not take a commission in the regular army, but the Dr. Davis referred to by Max Meyerhof is THOMAS DAVIS, Assistant Surgeon, 26 Dragoons (afterwards 23 Dragoons), 25 June, 1801: Hospital Mate, 22 May, 1800: Resigned 1805.

Yours truly,

R. R. JAMES.

NOTES

Illustration Blocks

As time goes by the number of blocks for illustrations increases to such an extent that it is impossible to find space in which to house them. Our printers keep all colour blocks, but the half-tones and line drawings have to be scrapped after about five years in order to save space.

It has occurred to us that authors of papers might like to buy the blocks of their illustrations at a reduced rate; and the management of the journal has decided that, for the future as soon as the type is distributed (that is, three months after the date of issue), authors shall be given the option of purchasing their blocks at a uniform rate of ten shillings per block, *i.e.*, rather less than half the initial cost. We propose to issue a slip to be attached to the galley-proofs. Should any author wish to take advantage of the offer he will only have to fill in the slip and forward it, together with a cheque for the amount, to the Manager, *British Journal of Ophthalmology*, 24, Thayer Street, W.1.

Dutch Ophthalmological Society

IN June, 1932, the Dutch Ophthalmological Society (Nederlandsch Oogheelkundig Geselschaf) will celebrate its 40th anniversary. The meeting will be held at Gröningen in Professor Rochat's clinic. In honour of the occasion a lectureship has been founded in memory of Donders. The Donders lecture will be delivered every five years. Professor Vogt, of Zürich, has been invited to deliver the first Donders lecture and has accepted the invitation. A medal has been struck and will be presented to each lecturer.

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Oxford Ophthalmological Congress

THE 22nd Annual Meeting of the Oxford Ophthalmological Congress has been arranged for July 7, 8 and 9, 1932, at Keble College, Oxford. The provisional programme is as follows:

July 7.—Discussion on the "Treatment of non-paralytic strabismus excluding operative details." Dr. Luther C. Peter, of Philadelphia, will open the discussion and the following have arranged to take part in it: Mr. Bernard Chevasse, Mr. Ormond, Mr. Alabaster, Mr. Williamson-Noble, Dr. Stewart Barrie and Mr. George Young.

July 8.—The Doyne Memorial Lecture will be delivered in the forenoon by Professor van der Hoeve, of Leiden. The lecture is entitled "The ocular signs in the phakomatoses of Bourneville, von Hippel-Lindau and von Recklinghausen."

Dr. Canti, of London, has promised to give a kinematograph demonstration of living cells and the influence of radium on malignant cells.

Papers have also been promised by Mr. Burdon-Cooper and Professor Pascheff of Sofia.

The usual scientific and commercial museum will be open to members and the annual dinner will be held in Keble College Hall on July 7, at 7.45 p.m. The Master, Mr. C. H. Walker and Mrs. Walker will receive the guests.

Further particulars can be obtained from the secretary, Mr. C. G. Russ Wood, Hill House, Atterbury Road, Iffley, Oxon.

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Appointments

THE following appointments have recently been made at the Eye, Ear and Throat Hospital for Shropshire and Mid-Wales, Shrewsbury:—Consulting Ophthalmic Surgeon, Mr. C. G. Russ Wood; Senior Surgeon, Dr. F. A. Anderson; Junior Surgeon, Dr. G. W. Morey.

FUTURE ARRANGEMENTS

1932

May 12-14.—Annual Congress of the Ophthalmological Society of the United Kingdom, at Edinburgh.

June 7.—Midland Ophthalmological Society, at Gloucester Royal Infirmary.

June 10.—Section of Ophthalmology, Royal Society of Medicine. (Annual Meeting).

October 4.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

CONTEMPORARY OPHTHALMIC LITERATURE

American Journal of Ophthalmology. *March, 1932.*

FRIEDENWALD. Some factors concerned in the success of operations for glaucoma.
MONCRIEFF, COULTER and HOLMQUEST. Experimental studies in diathermy applied to the eye and orbit.
PROCTOR, FINNOFF and THYGESON. Negative inoculation with *Bacterium granulosis*.
DAVIS. Tribromethanol (avertin) as an anesthetic in eye surgery.
BOTHMAN. Double puncta and double canaliculi of the upper lid.
BERENS and STARK. Studies in ocular fatigue.
FEJER. The fate of foreign bodies which remain inside the eye.
WALKER. Legal phases of industrial ophthalmology.
ARGAÑARAZ. A practical device for radiographic examination of the optic foramen.

Archives of Ophthalmology. *February, 1932.*

JAMES. Thomas Gataker: an eighteenth century English surgeon with ophthalmological leanings.
KIEHLE. The aftermath of cases of intra-ocular foreign body.
DUANE. Diplopia and other disorders of binocular projection.
MARLOW. Visual fields and chronic glaucoma. The effect of reduced illumination.
BERLINER. Cysts of the cornea.
KIRBY. The anterior vitreous in health and in disease.
GOLDSTEIN and WEXLER. Spongioneuroblastoma of the optic nerve in neurofibromatosis (Recklinghausen).
KLAUDER. Ocular syphilis. 2. Factors influencing the localisation of syphilis in the eye.
HAESSLER and SQUIER. Measurements of retinal vessels in early hypertension.
SWAB. Amblyopia from ethylhydrocupreine.
BOTHMAN. Refraction changes in the eyes of children under six years of age.

March, 1932.

CROSS. Ocular injuries. Their treatment.
SHERMAN. Prognosis of certain eye injuries.
ZIMMER. Workmen's compensation problems.
PELOUZE. Ophthalmologic importance of focal infective prostatitis.
PASCAL. The ioskiascopy test.
FERREE and RAND. Ways in which distance of the test field affects determinations of retinal sensitivity.

BOTHMAN. Homatropine and atropine cycloplegia. A comparative study.
BLATT. The correction of high myopia by Mueller's contact glasses.
BURCH. Orbital metastases from malignant tumours of the supra-renal.
GOLDSTEIN and WEXLER. Eyes of irradiated human embryo. Further observations.

Bulletin Société Belge d'Ophtalmologie. *November, 1931.*

ALLAERTS. A rare case of intra-ocular foreign body.
DE VAUCLEROY. Bilateral colobomata of the iris and the choroid.
——— Transient oedema of the papilla and the macula.
COPPEZ, J. Nodular keratitis of Groenouw.
COPPEZ, H. On a new case of congenital absence of lateral movements of the eye. (Syndrome of Stilling).
COPPEZ, L. A case of pseudo foreign body of the eye.
WEEKERS and HUBIN. Spontaneous cure of retinal detachment. What are the possibilities of functional restoration of a detached retina?
BADOT. Melanosarcoma of the choroid of a peculiar development.
LEPLAT. Ophthalmic herpes with paresis of all the ocular muscles and retrobulbar neuritis of the same side.
——— Is the vitreous a tissue?
DE METS. The previous condition of eyes in industrial accidents.
VAN LINT. Blepharochalasis in an infant of eight years.
MARBAIX. Extraction of a foreign body from the orbit complicated by ptosis.
KLEEFELD. The grille as a retinal micrometer.
DE JAEGER. Examination for diplopia with the red glass.
VAN DUYSE. Acquired unilateral elephantiasis of the lids.
FRANÇOIS. A case of infected ethmoidal mucocele.
——— Supero-internal osteoperiostitis of the orbit symptomatic of an infected frontal mucocele accompanying a chronic ethmoidal and double maxillary sinusitis.
FRITZ. Suppleness, calibre and tension of the retinal artery.
VAN CANNEYT. Wassermann reactions of the aqueous humour of the normal and syphilitic rabbit, before and after various injections into the anterior chamber.
BICHELONNE. Considerations of double focus lenses.

Annales d'Oculistique. *February, 1932.*

MORAX. Diplobacillary infection.
LARRSON. The intra-ocular vessels of the anterior segment and their influence on the intra-ocular tension.
MICHAÏL. Metastatic adeno-carcinoma of the choroid of probable intestinal origin.
SÉDAN. The use of nascent silver iodide in ophthalmology.

Revue Internationale du Trachome.

CATTANEO. Unilateral "sultracoma."
MORAX. So-called swimming-bath conjunctivitis.
TALBOT. Trachoma in the military territories of Southern Tunisia.
——— A year of school prophylaxis of trachoma in Southern Tunisia.
REDSLOB. The trachoma of Alsatian soldiers transported to the Russian front.
ROCHE. Trachoma and regulations.
MOTAIS. On the subject of trachomatous infection of European children in the colonies.
BARONI and MICHAIL. Researches on the preservation of the trachoma virus.
MICHAIL and VANCEA. Some experimental facts of trachoma.
ROQUES. An important focus of trachoma in Rabat (Morocco).
SÉDAN. Familial trachoma with pannus. Treatment with Jacobson's solution.
FEHMI. Tuberculin treatment in trachoma.
JANAWOSKA. The trachomatous and tuberculous patient.

Archiv für Ophthalmologie. Vol. CXXVIII, Part 1, 1932.

V. HIPPEL. Clinical observations of some duration.
——— Further observations on the question of rhinogenous retrobulbar neuritis with observations on unusual cases of familial optic nerve disease.
MICHAIL and VANCEA. Is there an internal secretion of the lacrimal gland? The physico-chemical and pharmaco-dynamical action of extract of lacrimal gland.
OHM. On nystagmus.
COLENBRANDER. Tables and observations on localisation of tears in the retina.
KREIKER. Observations on the international standardisation of visual acuity.
KRAVKOF. On the influence of contiguous inflammation on the light difference appreciation.
CUSTODIS. On cysts of the sclera.
SONDERMANN. Observations on our knowledge of the cornea, sclera, conjunctiva and pupillary membrane and also on the question of the anterior vitreous.
HESSE. On eye movements and squint.
VON PFLUGK. A new method of investigation of accommodation.

Klinische Monatsblätter für Augenheilkunde. *March, 1932.*

SCHEERER. A case of glioma in the region of a persistent hyaloid artery.
MARCHESANI. On the measurement of the industrial incapacity due to myopia.
LÖWENSTEIN. The pathogenesis and treatment of interstitial keratitis.
VELHAGEN, JUN. The appearance of holes in secondary detachment, also an observation on the question of juvenile detachment in emmetropes.
BÖMER. On a case of leprosy of the eyes.
BALCAREK. A peculiar type of cataract (siderosis lentis?) after trauma.
LINDENMEYER. An angioma of the choroid.
HARTLEIB. Exercise and measurement in the treatment of squint.
SZABÓ. Haemangioma cavernosum in connection with the lacrimal gland.
MIKLÓS. The appearance in the conjunctival sac of new bactericidal material.
ISAKOWITZ. Bilateral ring-shaped vitreous opacity (senile vitreous ring of Vogt).
STEIN. A modification of Löwenstein's lip clamp for mucous membrane plastic operations.
SALZER. A lens without a nucleus or applanatio corneae?
DUDINOW. An echinococcus of the orbit and injury.
PAVIA. A new apparatus for the investigation of the fundus in red-free light.
HARTINGER. Observations on the preceding article.

Annali di Ottalmologia e Clinica Oculistica.

September-October, 1931.

CIRINCIONE Points in ophthalmic treatment (diseases of the lens).
GALLERANI. Phenomena of apparent simultaneous contrast.
SANTONASTASO. Ocular changes in leprosy.
ZANETTIN. Behaviour of the central and peripheral light sense in chronic simple glaucoma.

Archivio di Ottalmologia. *February, 1932.*

ROSSI. Primary glaucoma and organic constitution (*cont. and end*).
MAZZI. The fatigue type of visual field in melancholics (*end*).

Bollettino d'Oculistica. *February, 1932.*

NICOLATO. Contribution to our knowledge of the etiopathogenic value of the fat content of the Meibomian secretion in regard to the origin and development of chalazia.
ALAJMO and SALA. The density of the living lens in connection with the age and state of refraction.
PETRAGNANI. On antibodies in the aqueous of primary and secondary formation.

BIETTI. On an interesting form of "initial epithelioma" of the cornea.
GALLENGA. Extensive fusiform pigmentation of the posterior surface of the cornea (Krukenberg).
CORDERO. On a case of juxta-papillary leucosarcoma.
VITTADINI. A case of malignant rhabdo-myoma in the external rectus of an old man.

Lettura Oftalmologica. *February, 1932.*

BAQUIS. Magnetic foreign bodies in the lens.
FILATOW. Seborrhoea of the Meibomian glands and its consequences.
COCUZZA. On a case of cysticercus hidden beneath the upper lid of an adult.

Rassegna Italiana d'Ottalmologia. *January-February, 1932.*

GALLENGA. The elastic tissue of the tarsus in generalised argyrosis.
OVIO. The discord of the two eyes in reading.
FAVALORO. Bacteriological and experimental research on trachoma with particular regard to the Bacterium granulosis (Noguchi).
TIRELLI. On congenital fistula of the lacrimal sac.
VITA. On the prismatic effect of decentration of meniscus lenses.
GALLENGA. Contribution to the embryological descriptive and topographical study of the lacrimal muscle of Duverney-Horner.

Revista Oto-Neuro-Oftalmologica. *November-December, 1931.*

BUSACCA. On orbital phlegmon.
SILVAGNI.—On orbital complications of maxillary sinusitis.

Archivos de Oftalmologia Hispano-Americanos. *March, 1932.*

PEREZ. Characteristics of diplopia in paralysis of the vertical motor muscles.
ALLENDE. Bilateral cataract.
FERRER. Tonometry before and after the operation for cataract.

April, 1932.

CHARLIN. Neuritis of the nasal nerve from general causes.
GARRETON. The retinitic diabetic.
LUQUE. Binasal hemianopia.
BARRENECHFA. Intra-capsular extraction in the ophthalmic clinic of Salvador.
TEJEDA. Phlyctennlar conjunctivitis and tuberculosis.

Revista Cubana de Oto-Neuro-Oftalmiatria.

January-February, 1932.

FERRER. Proliferating retinitis and multiple aneurysms.
HOFFMANN. Treatment by gold for ocular affections in leprosy.
KRUCKMANN. Intra-capsular extraction of cataract.
BARRIERE. On haemotherapy and sympathetic ophthalmitis.

Revista Oto-Neuro-Oftalmologica y de Cirugia Neurologica.

March, 1932.

RISER, MERIEL and PLANQUES. Vascular spasms.
PAVIA. A case of Stargardt's disease.
MENDOZA. Practical ophthalmology: canalisation and disinfection of the anterior chamber by means of a tag of conjunctiva.
PAVIA. A case of coloboma of the lens and other ocular malformations.

April, 1932.

FUCHS. His journey in South America.
RISER, MERIEL and PLANQUES. Vascular spasms.
BENJAMIN. A cure of thrombosis of the cavernous sinus.
PAVIA and ARANA. A serous Tenonitis.